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Summa medlemmar 397.

Eventuella rättelser i fråga om medlemmarnas namn, titel eller adress liksom ock framför allt a d r e s s ä n d r i n g a r torde anmälas pr brevkort till A. Jansson, Stockholms Högskola, Stockholm Va.

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ZUR EPILOBIUM-FLORA SÜDAMERIKAS.

VON

GUNNAR SAMUELSSON.

Vor einigen Jahren veröffentlichte ich in dieser Zeitschrift (Bd. 17, 1923) eine Revision der südamerikanischen *Epilobium*-Arten. Diese Arbeit war in erster Linie auf den Sammlungen einiger skandinavischen und zentraleuropäischen Museen gegründet. Seitdem habe ich neue Materialien aus dem Herb. Delessert (Genf), dem Field Museum of Natural History (Chicago), dem Gray Herbarium (Cambridge, Mass.), dem U. S. National Museum (Washington, D. C.) und der Academy of Natural Sciences of Philadelphia erhalten. Besonders in den amerikanischen Sammlungen fand ich zahlreiche Nummern, die ich bisher nicht kannte.

Unter den früher nicht untersuchten Nummern fand ich keine einzige, auf Grundlage welcher ich eine neue Art aufstellen möchte. Doch will ich nicht unerwähnt lassen, dass ich wenigstens zwei Fragmente aus den argentinisch-chilenischen Anden gesehen habe, welche ich nicht den bisher bekannten Arten zuweisen kann und die wahrscheinlich neue Arten vertreten, obgleich ich solche nach so kümmerlichen Materialien nicht beschreiben will. In meiner Arbeit von 1923 beschrieb ich eine Reihe von neuen Arten. Einige von diesen sind in den jetzt untersuchten Sammlungen wieder zum Vorschein gekommen und haben sich als gute Arten bewährt. In einigen Fällen muss ich dagegen meine Neuschöpfungen wieder einziehen, da es sich erwiesen hat, dass sie durch Zwischenformen mit anderen Arten allzu eng verbunden sind. Leider sind mir keine neuen Sammlungen aus Süd-Chile — Patagonien (südlich von etwa 36° S. Br.) vor Augen gekommen, was sehr zu bedauern ist, da aus diesem Gebiet besonders zahlreiche wenig bekannte

Arten — teilweise von mir selbst — beschrieben sind. Da ich mich somit auch meinen eigenen Schöpfungen gegenüber kritisch stellen muss, will ich ausdrücklich betonen, dass ich es dessenungeachtet richtiger finde, abweichende, gut entwickelte Nummern zur Grundlage neuer Arten zu machen, als dieselben mit früher bekannten zu vereinigen und dieselben dadurch vielleicht uneinheitlich zu machen.

Unten gebe ich teils einige kritische Bemerkungen zu verschiedenen Arten, teils eine Aufzählung aller nicht früher von Haussknecht in seiner Monographie der Gattung Epilobium (Jena 1883) oder von mir selbst erwähnten Nummern. Der Einfachheit halber führe ich die Arten diesmal in Buchstabenfolge auf. Für die benützten Herbarien verwende ich folgende Abkürzungen:

D = Herb. Delessert. P = Academy of Sciences of Philadelphia.
F = Field Museum. S = Herb. Stockholm.
G = Gray Herbarium. U = U. S. National Museum.

E. aequinoctiale Sam.

Ecuador. Prov. Pichincha: Pichincha, 3500 m (21. IV. 1927 G. Firmin n. 98: U); Valle de La Magdalena — Chillogallo, 2800 m (7. VII. 1927 Firmin n. 99: U); San Ignacio, 3350 m (14—19. VIII. 1923 H. E. Anthony u. G. H. H. Tate n. 137: U); Prov. Tungurahua: Ambato, 2600 m (21. IX. 1923 A. S. Hitchcock n. 21721: G, U).

E. andicolum Hausskn.

Meine schon früher ausgesprochenen Zweifel (l. c., p. 255) daran, dass diese Pflanze von *E. denticulatum* Ruiz et Pavon wirklich spezifisch verschieden sein sollte, haben durch die neu eingegangenen Materialien eine derart kräftige Stütze erhalten, dass ich jetzt nicht länger zögere, beide als eine Art zusammenzuziehen. *E. andicolum* wird dann nur eine robuste Form von *E. denticulatum* var. *macropetalum* Sam.

E. Arechavaletae Lévl.

Ich hatte übersehen, dass Léveillé in seinem Catalogue des Plantes de Yun-Nan (1915) eine Abbildung dieser Pflanze gegeben hat. Sie bestätigt durchaus meine Auffassung, dass es sich um ein Synonym von *E. brasiliense* Hausskn. handelt.

E. argentinum Sam.

Argentina. Cordillera de Mendoza: Rio Salado sup., an schattigen Quellen (25. I. 1892 T. Stuckert n. 7082, von Hausskнecht als *E. Bonplandianum* Kunth bezeichnet: D).

E. Asplundii Sam.

Von dieser Pflanze hatte ich im Sommer 1923 im botanischen Garten zu Uppsala lebende Exemplare, die aus Samen der Originalnummer aufgezogen waren. Es zeigte sich dabei, dass die von mir angegebenen Unterschiede gegenüber *E. denticulatum* Ruiz et Pavon var. *macropetalum* Sam. nicht erblich sind. In unmittelbarer Nähe der erwähnten Exemplare hatte ich eine Nummer von typischem *E. denticulatum* in Kultur und konnte somit leicht feststellen, dass beide Pflanzen zu einer Art gehören.

E. assurgens Sam.

Columbien. Canoas (XII. 1917 Bro. Ariste-Joseph n. A 98: U); Dep. Norte de Santander: Loso und Umgebung (N von Toledo), im Walde längs eines Flusses, 2200—2400 m (6—7. III. 1927 E. P. Killip u. A. C. Smith n. 20391: U); Dep. Huila: Cordillera Oriental, E von Neiva, im Walde, 1800—2300 m (1—8. VIII. 1917 H. H. Rusby u. F. W. Pennell n. 880: U), »Balsillas» am Rio Balsillas, 2000—2100 m (3—6. VIII. 1917 Rusby u. Pennell n. 728 p.p.: G, U mit *E. meridense* Hausskn. gemischt); Dep. El Cauca: »Calaguala», Coconuco, an feuchten Stellen unweit Rio San Andreas, 2700—3000 m (14, 18. VI. 1922 Pennell n. 7149: G, U), Rio Ortega, gegen »El Ramal», im Walde, 1900—2200 m (2. VII. Pennell u. Killip n. 8083: G, U), »San José», San Antonio, 2300—2500 m (1. VII. 1922 Pennell n. 7653: G, U); Dep. Tolima: Paramo de Ruiz, 3400—3700 m (16—17. XII. 1917 Pennell n. 3070: G, U).

Unter diesem Material kommen sowohl weiss- als violettblütige Individuen vor. Sonst stimmen die verschiedenen Nummern im grossen und ganzen gut miteinander überein. Die Blätter sind meist etwas deutlicher gestielt als am Original, obgleich immer sehr kurz. Die Abgrenzung dieser Art gegenüber *E. meridense* Hausskn., besonders dessen Var. *Helodes* (Lévl.) Sam., ist bisweilen sehr schwierig. Die grössere Kahlheit der Blätter und vor allem die auf zwei Seiten beschränkte Behaarung des Stengels stellen fast

die einzigen Unterschiede dar. Man pflegt indessen bei den Epilobien grosses Gewicht auf die Behaarungsverhältnisse des Stengels zu legen, ob dieser nämlich ringsum oder nur auf zwei Seiten behaart ist. Unter derartigen Verhältnissen und bei Kenntnis, wie geringfügige Merkmale gute Arten unter den europäischen Epilobien unterscheiden können, kann ich mich wenigstens vorläufig nicht entschliessen, *E. assurgens* unter *E. meridense* einzureihen. Nachdem ich jetzt den betreffenden Formenkreis besser kennen gelernt habe, bin ich sehr geneigt anzunehmen, dass Haussknecht unter *E. Bonplandianum* Kunth in erster Linie *E. assurgens* verstanden hat. Vgl. übrigens meine Ausführungen l. c., p. 292.

E. australe Poepp. et Hausskn.

Chile. Prov. Curicó: Cord. Volcán Peteroa, 2500 m (I. 1925 E. Werdermann n. 599 f. ad var. *Lechleri* (Phil. et Hausskn.) Sam.: F, G, S); Prov. Ñuble: Baños de Chillan, an feuchten Hängen, 2100 m (29—31. I. 1925 F. W. Pennell n. 12437 var. *Lechleri*: F, G, S, U); Baños de Chillan, auf Bachwiesen, 1800—2000 m (29—31. I. 1925 Pennell n. 12413 f. ad var. *andinum* (Phil.) Sam.: F, G); Prov. O'Higgins: El Teniente, unweit Rio Coya am Rande von Wassertümpeln, 2700—2900 m (26. I. 1925 Pennell n. 12321 var. *interruptum* Sam.: F, G, S, U); am selben Orte, an Bächen, 2500—2800 m (26. I. 1925 Pennell n. 12296 f. ad var. *interruptum*: F, G, U).

Das gute Pennellsche Material hat meine Auffassung bestätigt, dass *E. Lechleri* von *E. australe* nicht spezifisch verschieden ist.

E. Barbeyanum Lévl.

Chile. Prov. Atacama, Dept. Vallenar: Rio de la Laguna, E von Vallenar: zwischen Potrero Toledo und Juntas Pescado, auf quelligen Stellen in Wiesen, 2750 m (4—5. I. 1926 I. M. Johnston n. 6009: G, S), Quebrada Alfalfa (Q. de los Pozos), an kiesigen Bachufern, 2800 m (7—8. I. 1926 Johnston n. 5996: G. S).

Die jetzt vorliegenden Exemplare sind viel besser entwickelt als die früher untersuchten, die meiner Beschreibung (l. c., p. 265) zu Grunde liegen. Sie haben den Habitus einer Sonnenform. Der Stengel ist niedriger (2,5—3,5 dm hoch), kräftiger und reicher verzweigt. Die Ausläufer sind nur teilweise obererdig, öfters

untererdig und haben die Form von ausgezogenen, dezimeterlangen, schlanken, weisslichen Gemmen etwa vom Typus des *E. alsinifolium* Vill. Letzteres Merkmal stellt eine Annäherung an der Artengruppe Australia dar, und es fragt sich sogar, ob es nicht richtiger wäre, unsre Art in diese Gruppe überzuführen.

E. brasiliense Hausskn.

Argentina. Prov. Córdoba: Puesto de Tanti (15. XII. 1886 T. Stuckert n. 4427: D); Achala, Despenadero—Almedo (13. XII. 1901 Stuckert n. 10542: D, zwei Bogen, davon einer von Léveillé als *E. denticulatum* Ruiz et Pavon, der andere als *E. puberulum* Hook. et Arn. bestimmt).

E. caesiovirens Sam.

Chile. Prov. Ñuble: Baños de Chillan, Aguas Calientes, 2200 m (III. 1927 E. Werdermann n. 1314: S).

E. chilense Hausskn.

Chile. San Felipe (XI. 1923 Bro. Claude-Joseph n. 2488); Santiago (X. 1922 Claude-Joseph n. 2214 var. *latifolium* Hausskn.: U); Bureo (XI. 1926 Claude-Joseph n. 3455 var. *macrum* Hausskn.: U.)

E. Cunninghami Hausskn.

Patagonien. Prov. Chubut: Cholila (1. II. 1901 N. Illin n. 129 in Herb. T. Stuckert n. 18113: D).

Feuerland. Philip bay (IV. 1867 R. O. Cunningham: G).

E. deminutum Sam.

Bolivien. Kala-Huyu Mines, 4200 m (18. X. 1923: U).

Diese besser entwickelten Exemplare stimmen in allem Wesentlichen mit dem Original überein. Ich kann die Beschreibung ergänzen: Stigma clavatum, circ. 1 1/4 mm longum, 1/2 mm latum, basi attenuatum, stylo subduplo brevius. Semina fusiformia, apice breviter pellucido-appendiculata, circ. 1 mm longa, 1/3 mm lata, testa papillosa.

E. denticulatum Ruiz et Pavon.

Ecuador. Quitensian Andes (1855 J. P. Couthoy: G); Quito (Prof. Orton: G mit *E. meridense* Hausskn. gemischt); Chimborazo,

Urbina, ca. 3400 (22—28. X. 1923 H. E. Anthony u. G. H. H. Tate n. 387: U); Umgebung von Nabón (25. IX. 1918 J. N. Rose n. 23016: U).

Peru. Ollantaytambo, 3000 m (23. IV. 1915 O. F. Cook u. G. B. Gilbert n. 269: U); Tambo de Vaca, 3900 m (10—24. VI. 1923 J. F. Macbride n. 4373: F, G); Rio Blanco, 3600 m (Macbride u. Featherstone n. 677: F, G); Casapalca, 4650 m (21. V. 1922 Macbride u. Featherstone n. 857: F, G); La Quinua, 3600 m (14. V. 1922 Macbride u. Featherstone n. 2023: F, G); Prov. Paucartambo: Paucartambo Valley, Hacienda Churú, 3500 m (I. 1926 u. I. 1927 F. L. Herrera n. 1026: F, G, U; n. 1392 u. 1414: U); Prov. de Anta: Hacienda Maryu, 3400 m (V. 1925 Herrera n. 690: F, U); Dep. Cuzco: Paucartambo to Tres Cruces, Cerro de Cusilluyoc, 3200—3400 m (F. W. Pennell n. 14157: F, G); La Raya, 4400—4500 m (22. IV. 1925 Pennell n. 13514: F); Cuzco, 3400—3600 m (III. 1925 Herrera n. 536: C, U); Prov. Moquegua: Saulapa unweit Carumas, 3300 m (3. III. 1925 A. Weberbauer n. 7337: F).

Bolivien. Umgebung von La Paz (IV. 1919 Bro. Claude-Joseph n. 1107: U).

Chile. Prov. Tarapacá: Cord. Quebrada de Quipisca, Noasa, 3500 m (III. 1926 E. Werdermann: S).

Argentina. Prov. Catamarca: Común Andalgalá (1894 P. Jörgensen n. 1057: G, U); El Landallo (20. II. 1897 P. Jörgensen n. 1205: U); Prov. Tucumán: Dep. Chicligasta, Estancia Las Pavas—P:to La Cascada, 2700 m (11. III. 1924 S. Venturi n. 3033: U); Prov. Córdoba: Sierra Achala, Cerro de las Gigantes (25. III. 1886 T. Stuckert n. 3854: D).

Var. *macropetalum* Sam.

Peru. Südhänge des Chachani, N von Arequipa, 2400 m (III. 1920 F. E. Hinkley n. 65: G, U); Umgebung von Arequipa (28. VIII. 1914 J. N. Rose n. 19013: U); Umgebung von Oroya, 3300—4500 m (A. S. Kalenborn n. 19: U); Dept. Puno: Araranca, 4100—4200 m (21. IV. 1925 F. W. Pennell n. 13432: F, G, S, U); Prov. Huanta: Berge NE von Huanta, 3100—3200 m (1—10. II. 1926 A. Weberbauer n. 7505: F); Prov. Huancané: Occa Pampa, 3965 m (10. XII. 1919 R. S. Shepard n. 78: G, U); Dept. Cuzco: Ollantaitambo, 2850—2900 m (26. IV. 1925 Pennell n. 13670: F, G, S, U); Ollantaytambo, 3000 m (11. V. 1915 O. F. Cook et G. B. Gilbert n.

635: U), Sacsahuaman oberhalb Cuzco, 3500—3600 m (24. IV. 1925 Pennell n. 13591: F).

Bolivia. Unduavi, 2400 m (X. 1885 H. H. Rusby n. 1808: F, P).

Var. *aberrans* Sam.

Während einiger Jahre hatte ich diese Pflanze in Kultur und konnte mich dadurch überzeugen, dass sie von *E. denticulatum* (s. str.) spezifisch verschieden ist. Dagegen hat es sich bei erneuerter Untersuchung an den jetzt reichlich vorliegenden Materialien erwiesen, dass sie in den Rahmen von *E. meridense* Hausskn. var. *Helodes* (Lévl.) Sam. fällt.

E. denticulatum × *Haenkeanum*.

Bolivia. Unweit La Paz, 3000 m (VIII. 1885 H. H. Rusby n. 1805: F, P, U mit *E. denticulatum* gemischt); La Paz, 3700 m (3. III. 1907 O. Buchtien n. 37: U mit *E. Haenkeanum* gemischt).

Diese Nummern stimmen mit den von mir früher (l. c., p. 254) beschriebenen vollständig überein. Die Ausbildung der Samen ist eigentlich besser, als sie bei einem *Epilobium*-Bastard sein sollte. Ich glaube aber trotzdem nicht, dass es sich um eine selbständige Art handelt.

E. fragile Sam.

Peru. Casapalca, in Felsenspalten, 4650 m (21. V. 1922 Macbride et Featherstone n. 867: F, G).

Das freilich sehr spärliche Material stimmt mit dem Original aus den Hochanden von Bolivien vollständig überein. Die Blüten sind weiss.

E. glaucum Phil.

Chile. Prov. Aconcagua: Juncal, 2400—2600 m (18. III. 1925 F. W. Pennell n. 12982: F, G, U, u. n. 12992: G); Curicó (I. 1928 Bro. Claude-Joseph n. 5646: U); Maipo, 2600 m (11. I. 1924 Claude-Joseph n. 2928: U); Rio Blanco (I. 1924 Claude-Joseph n. 2480: U); Prov. Malleco: »Buenavista» am Fusse von Volcán Tolguaca, im felsigen Flussbett des Rio Blanco, 1100—1200 m (23—25. II. 1925 Pennell n. 12817; F, G); Prov. O'Higgins: El Teniente, unweit Rio Coya, 2700—2900 m (26. I. 1925 Pennell n. 12344: F, G); Prov. Ñuble: Baños de Chillan, 1700—1900 m (29—31. I. 1925 Pennell n.

12389: G); Baños de Chillan, Aguas Calientes, 2200 m (III. 1927 E. Werdermann n. 1312: S).

Argentina. Cordillera de Mendoza: Rio Salado sup. (29. I. 1892 T. Stuckert n. 7150: D); Gobernación del Nequen: Cañon de los cipreses, Arroyo Catanlil (27. III. 1888 Stuckert n. 6322: D).

E. Haenkeanum Hausskn.

Peru. Arequipa, unweit des Harvard Observatory (XII. 1911 W. E. Castle n. 5: G); Matucana, 2400 m (Macbride u. Featherstone n. 90: F, G).

Bolivien. Cañon des La Paz-Flusses, 3350 m (1. VIII. 1920 R. S. Shepard n. 157: G mit *E. hirtum* Sam. gemischt); La Paz, 3500 m (19—20. V. 1925 F. W. Pennell n. 14217: F, G, U); La Paz, 3700 m (3. III. 1907 O. Buchtien n. 37: U mit *E. denticulatum* × *Haenkeanum* gemischt); Umgebung von La Paz, 3000 m (X. 1885 H. H. Rusby n. 1805: F, U mit *E. denticulatum* × *Haenkeanum* gemischt, n. 1806: F, G, P, U); Umgebung von La Paz, 3000 m (1889 M. Bang n. 75 a: P, U); La Paz, Lugares pantanosos, 3700 m (3. III. 1907 O. Buchtien n. 100: F).

E. hirtum Sam.

Bolivien. La Paz, in Gräben und an anderen sumpfigen Stellen, 3450—3700 m (26. II. 1907 O. Buchtien n. 38: U; 8. III. 1919 Buchtien n. 531: F, U); La Paz (24. III, 1920 E. W. D. u. M. M. Holway n. 453: U); Umgebung von La Paz (1889 M. Bang n. 75: G, P, U); Cañon des La Paz-Flusses, 3350 m (1. VIII. 1920 R. S. Shepard n. 157: G mit *E. Haenkeanum* Hausskn. gemischt, U); Yungas 1800 m (1885 H. H. Rusby n. 1807: F, G, P, U); Illimani, Cotaña, 2500 m (XI. 1911 O. Buchtien n. 3224 u. 3225: U); Illimani, Tal des Rio Palca, 2800 m (XII. 1923 Bro. Julio n. 109: U).

Fast sämtliche Nummern waren als *E. andicolum* Hausskn. bezeichnet. Dessenungeachtet eine sehr freistehende Art.

E. interruptum Sam.

Schon bei der Beschreibung dieser Pflanze (l. c., p. 286) hob ich hervor, dass sie *E. australe* Poepp. et Hausskn. so nahe steht, dass sie fast ebensogut als Varietät dieser Art aufgefasst werden könnte. Übergangsformen waren mir indessen damals nicht be-

kannt. Nachdem ich jetzt eine deutliche Übergangsform gesehen habe (Pennell n. 12296), und zwar von einem Standort, an dem am selben Tage ein typisches *interruptum* gesammelt wurde (Pennell n. 12321), finde ich es richtiger, nur eine Var. *interruptum* Sam. zu unterscheiden. Vgl. oben S. 4.

E. Lamyi F. Schultz.

Chile. Santiago (I. 1919 Bro. Claude-Joseph n. 931: U); Nunoa bei Santiago (28. XI. 1920 Claude-Joseph n. 1295: U).

Die beiden Nummern stimmen so nahe miteinander überein, dass man fast glauben könnte, dass sie aus ein und demselben Bestand stammen. Etwaige Unterschiede gegenüber der europäischen Pflanze habe ich nicht finden können. Die Art kommt auch hier gern an ruderalen Stellen vor. Zweifellos ist sie in neuester Zeit aus Europa eingeschleppt worden.

E. magellanicum Phil. et Hausskn.

Chile. Prov. O'Higgins: El Teniente, am Rio Coya, 2700—2900 m (26. I. 1925 F. W. Pennell n. 12307: G).

Durch weisse Blüten und kaum rötlich angelaufene Früchte von der typischen Form etwas verschieden. Leider habe ich das Material bei der Zusammenstellung des Manuskriptes nicht zur Hand. Ich kann deshalb nicht entscheiden, ob nicht eher *E. caesiovirens* Sam. vorliegt.

E. meridense Hausskn.

Venezuela. Mérida, Paramo Sto. Domingo, 3600 m (12. IX. 1922 A. Jahn n. 1108: U); Mucubajá, 3000 m (13. IX. 1922 Jahn n. 1110: U).

Columbien. San Cristóbal unweit Bogotá (X. 1917 Bro. Ariste-Joseph n. A 75 a: U).

Diese Nummern sind die einzigen unter den neuen Materialien, die mit der Hauptform der Art, wie ich sie l. c., p. 257 aufgefasst habe, übereinstimmt. Indessen muss ich gestehen, dass es vielleicht richtiger wäre, den Formenkreis, den ich als Var. *Helodes* zusammenfasse, als Hauptform aufzustellen, umsomehr, da dieser Typus besser mit der Originalbeschreibung übereinstimmt und wirklich in den Anden von Mérida vorkommt, was ich bisher nicht wusste.

Var. *condensatum* Sam.

Ecuador. Umgebung von Las Juntas (28. IX. 1918 J. N. Rose n. 23178: U).

Andere Nummern stehen zwischen dieser Varietät und Var. *Helodes*. Da sie sich indessen dieser näher anschliessen, führe ich sie bei dieser auf.

Var. *Helodes* (Lévl.) Sam.

Venezuela. Hautes Andes de Truixillo et de Mérida (1842 M. J. Linden: D).

Columbien. Camino de Gachetá, 2200 m (X. 1920 Bro. Ariste-Joseph n. A 545: U); unweit Tequendama (VII. 1919 Ariste-Joseph n. A 387: G, U); Dept. Cundinamarca: Rio San Francisco, oberhalb Bogotá, 2700—2800 m (13. IX. 1917 F. W. Pennell n. 1953: U), Zipaquira, 2650 m (20—24. X. 1917 Pennell n. 2542: F, G, U); Dept. Tolima: »Rosalto» unweit Paramo de Ruiz, 2800—3100 m (15—17. XII. 1917 Pennell n. 2953: G, U); Dept. Caldas: Cerro Tatama, 3400—3700 m (8—10. IX. 1922 Pennell n. 10566: G, U), »Pinares» oberhalb Salento, 2700—2900 m (2—10. VIII. 1922 Pennell n. 9347: G, U), Paramo del Quindio, 3700—4200 m (15—20. VIII. 1922 Pennell u. T. E. Hazen n. 9989: G, U); Dept. Santander: Paramo de las Vegas, 3300—3700 m (20—21. XII. 1926 E. P. Killip u. A. C. Smith n. 15715: U), Paramo de Mogotocoro unweit Vetas, 3700—3800 m (18. I. 1927 Killip u. Smith n. 17646: U); Dept. Huila: »Balsillas» am Rio Balsillas, 2000—2100 m (3—6. VIII. 1917 Pennell u. Rusby n. 728 p.p.: F, U mit *E. assurgens* Sam. gemischt).

Ecuador. Quito (Prof. Orton: G); Umgebung von Cuenca (17—24. IX. 1918 J. N. Rose n. 22850: G, U); Prov. Tunguragua: Ficoa unweit Ambato (II. 1919 A. Pachano n. 145: U).

E. nivale Meyen.

Chile. Umgebung von Sewell, oberhalb Rancagua, 2350 m (XII. 1916 E. S. Bastin n. 16: U); Juncal auf dem Uspallata-Pass, 2200 m (II. 1903 O. Buchtien: U); Prov. O'Hoggins: El Teniente, unweit Rio Coya, 2500—2700 m (26. I. 1925 F. W. Pennell n. 12292: F, G).

Argentina. Cordillera de Mendoza: Rio Salado sup., Valle Hermoso (16. I. 1892 T. Stuckert n. 5860: D).

E. pauciflorum Phil.

Chile. Prov. Ñuble: Baños de Chillan, auf Felsen, 2000—2100 m (29—31. I. 1925 F. W. Pennell n. 12429: F, G, U).

Diese neue Nummer stimmt vollständig mit dem Originalmaterial überein und bestätigt durchaus meine Auffassung (l. c., p. 261), dass eine gute Art vorliegt.

E. puberulum Hook. et Arn.

Chile. Temuco (27. XII. 1905 R. Morton Middleton: D); Bureo (XI. 1926 Bro. Claude-Joseph n. 3454: U); Prov. Malleco: Curacautin, auf Felsen längs des Rio Blanco, 500—700 m (22. II. 1925 F. W. Pennell n. 12726: F, G); Valdivia (Reed: G).

E. valdiviense Hausskn.

Chile. Prov. Malleco: Curacautin, 500—700 m (22. II. 1925 F. W. Pennell n. 12715: F, G); »Buenavista» unterhalb Volcán Tolguaca, im felsigen Flussbett des Rio Blanco, 1100—1200 m (23—25. II. 1925 Pennell n. 12815: F, G).

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TEMPERATUR UND CHROMOSOMEN-KONJUGATION.

VON

OTTO HEILBORN.

Einleitung.

In einer früheren Arbeit (Heilborn 1928) habe ich die damaligen Resultate der Forschungen über die Zytologie der Apfelsorten kritisch zusammengefasst und einige Resultate eigener Untersuchungen mitgeteilt. Hier suchte ich unter anderem zu zeigen, dass die Temperatur einen wichtigen Einfluss auf die Reduktionsteilung in den Pollenmutterzellen der Äpfel habe, derart dass eine Erhöhung der Temperatur eine Schwächung der Chromosomenkonjugation bewirke. Eine starke Temperaturerhöhung verursacht daneben, in gewissen Fällen, eine Störung des Teilungsmechanismus, so dass eine regelrechte Spindelbildung ausbleibt.

Um eine bessere Auffassung von dem Einfluss der Temperatur auf die Reduktionsteilung in den Pollenmutterzellen der Apfelblüten zu erhalten, habe ich nun während der zwei letzten Jahre einige Thermostatversuche gemacht unter Benutzung eines Thermostates, der der landtwirtschaftlichen Versuchsanstalt zu Experimentalfältet bei Stockholm gehört. Für die Erlaubnis, diesen Thermostat zu benutzen — wodurch allein die vorliegende Untersuchung ermöglicht wurde — bin ich Herrn Professor Henrik Lundegårdh zum grössten Dank verpflichtet.

Als Hauptergebnis meiner Untersuchung stellte sich schon früh heraus, dass die Chromosomenkonjugation bei den Äpfeln sich in der Tat — wie ich in meiner obengenannten Arbeit vermutet hatte — durch Erhöhung der Temperatur eine oft beträchtliche Schwächung erleidet. Die Resultate meiner Untersuchungen über den Zusam-

menhang zwischen Chromosomenzahl und Reduktionsteilung einerseits, und Pollensterilität der Äpfel andererseits, beabsichtige ich, in einer späteren, grösseren Arbeit zusammenzufassen; die vorliegende Frage nach dem Zusammenhange zwischen Temperatur und Chromosomenkonjugation scheint mir aber von so grossem allgemeinem Interesse zu sein, dass eine separate Behandlung dieser letzten Frage an der Hand meiner Apfelstudien berechtigt sein dürfte. Im folgenden werde ich also über meine zytologischen Temperaturversuche berichten ohne Rücksicht auf ihre etwaige Bedeutung für die Frage nach den Ursachen der Pollensterilität der Äpfel. Ehe ich aber auf die Darstellung meiner Ergebnisse übergehe, wäre es angebracht, eine kurze Übersicht früherer Arbeiten über Temperatur und Reduktionsteilung zu geben.

Frühere Arbeiten über Temperatur und Reduktionsteilung.

Die älteren Untersuchungen über Einfluss der Temperatur auf die mitotischen Kernteilungen sind für die uns hier interessierende Frage von weniger Bedeutung. In mehreren neueren Arbeiten dagegen werden die meiotischen Teilungen in ihrem Verhältnis zur Temperatur eingehend untersucht. Einige dieser Untersuchungen behandeln nur die Frage nach dem Einfluss von Kälte auf die Meiosis, das heisst, sie umfassen Gefrierversuche. Die erste, die sich mit solchen experimentellen Versuchen beschäftigt hat, scheint Frau Borgenstam-Florin zu sein (Borgenstam 1922). Dabei ist jedoch zu beachten, dass Sakamura schon früher (Sakamura 1916) über einen Fall berichtet, wo einige Versuchspflanzen von *Vicia Faba* während der Reduktionsteilung zufällig von Schnee bedeckt wurden, wodurch als Resultat abnorme Pollenkörner entstanden. Auch in einer anderen älteren Arbeit (Cannon 1903) wird über einen ähnlichen Fall bei einem *Gossypium*-Bastard berichtet. Frau Borgenstam-Florin suchte durch hineinstellen in einen Kälteschrank die meiotischen Teilungen von *Syringa chinensis* zu beeinflussen. Als Hauptresultat ergab sich, dass die Kälte anscheinend eine vorübergehende Lähmung des Teilungsmechanismus bewirkte, wodurch später doppeltkernige Pollenmutterzellen sowie Kernverschmelzungen und Pollenmutterzellen und Pollenzellen mit verdoppelter Chromosomenzahl entstanden. Die Einzelheiten der Chromosomenkonjugation und Reduktionsteilung sind aber in diesem Falle nicht aufgeklärt worden.

Die von Belling (1925) berichteten Unregelmässigkeiten bei *Uvularia*-Arten scheinen durch stark schwankende Temperaturen veranlasst zu sein. Aus den Beobachtungen geht aber nicht hervor, ob es die niedrigen Temperaturen an sich oder die Schwankungen der Temperatur waren, welche die Unregelmässigkeiten bewirkt hatten. Der Verf. berichtet über »detachments», »nonconjunction» usw., hat aber keine experimentelle Untersuchungen gemacht.

Weitere Studien über Kältewirkungen sind später von Michaelis (1926, 1928) veröffentlicht worden. Die Versuchspflanzen gehörten zu den Gattungen *Epilobium* und *Oenothera*. Durch ein- bis mehrmaliges Abkühlen bis auf —4°—5° C. erhielt Michaelis allerlei abnorme Pollenkörner, die durch unregelmässige meiotische Teilungen entstanden waren. Von zytologischen Einzelheiten seien das mehrmals beobachtete Vorkommen von univalenten Chromosomen genannt sowie Störungen des Teilungsmechanismus mit mangelhafter Spindelbildung. Auch Kernverschmelzungen kamen vor, wodurch Pollenkörner mit erhöhter Chromosomenzahl entstanden.

Schliesslich sind zwei japanische Untersuchungen mit Kälteversuchen zu nennen, nämlich die Arbeit von Stow (1927), worüber unten näher berichtet wird, und die Arbeit von Shimotomai (1927) über *Liriope graminifolia* und *Scilla japonica*. Die letztgenannten Versuchspflanzen wurden bis auf ± 0° C. abgekühlt. Interessant ist es dabei, dass die Dauer des Versuches von Bedeutung für die Kältewirkung auf die Teilungen war; bei *Liriope* z. B. war 5—7-stündiges Abkühlen notwendig, um Abnormitäten hervorzurufen. Als Resultat des Abkühlens ergab sich häufiges Vorkommen von Störungen der Spindelbildung mit Zerstreuung von Chromosomen in das Plasma, sowie »frühzeitiges Auseinandergehen» homologer Elemente der Gemini mit darauf folgendem gleichzeitigem Auftreten von bi- und univalenten Chromosomen in den heterotypen Metaphasen. Die letztgenannte Erscheinung wäre vielleicht besser als teilweises Ausbleiben der Chromosomenkonjugation bezeichnet. Zuweilen drängen sich die Chromosomen in einen Klumpen zusammen, um später zu degenerieren.

Aus den umfangreichen Arbeiten von de Mol (am wichtigsten 1921, 1923, 1928) über *Hyacinthus, Tulipa* und *Narcissus* geht hervor, dass man durch verschiedenartige Behandlung der Zwiebel einen verschieden grossen Prozentsatz von diploiden und tetraploi-

den sowie sterilen Pollenkörnern in den Antheren erhalten kann De Mol selbst schliesst, 'dass durch die Temperatur vor der Meiosis eine gewisse »Empfindlichkeit» geschaffen wird, die zur Folge hat, dass dadurch bei einer gewissen Temperatur während der Meiosis Duplikation und Quadruplikation auftritt'. In gewissen Fällen erhielt De Mol abnorme Pollenkörner, wenn Zwiebeln vor der Reife aus der Erde herausgegraben und dann bei ziemlich hoher Temperatur getrocknet wurden. In anderen Fällen wird die Ursache der Dupli- bzw. Quadruplikation in der niedrigen Bodentemperatur während der Meiosis gesucht. Exakte Angaben über die Wirkung der Temperatur auf die Meiosis liegen aber nicht vor, und überhaupt scheint de Mol noch nicht die Reduktionsteilung der Versuchspflanzen untersucht zu haben.

Von Wärmeversuchen über die meiotischen Teilungen sind die von Sakamura und Stow (1926) über *Gagea lutea* zuerst zu erwähnen. Diese japanischen Forscher haben die Versuchspflanzen teils unter natürlichen Bedingungen (bei niedriger Temperatur) zytologisch untersucht, wobei die meiotischen Teilungen normal verliefen, teils haben sie Thermostatversuche ausgeführt. Es wurden fünf solche Versuche gemacht, nämlich bei 25° C. (15 Stunden), 30° C. (8 stunden), 30° C. (15 Stunden), 30° C. (22 Stunden) und 40° C. (6 Stunden). Durch diese Wärmebehandlung gelang es den beiden Autoren, eine Reihe von Unregelmässigkeiten der Reduktionsteilung hervorzurufen, die in eine ungleiche Verteilung der Chromosomen auf die vier Tochterkerne der Tetraden resultierte. Einige der Pollenkörner ergaben sich als hypo-, andere als hyperchromosomig. Es scheint, als ob ausgebliebene Chromosomenkonjugation dabei eine gewisse Rolle gespielt hatte, aus der Beschreibung oder aus den Figuren geht das aber nicht ganz klar hervor.

Völlig klar liegen aber die Ergebnisse bei den wichtigen Untersuchungen von Stow (1926, 1927) über den Einfluss der Temperatur auf die Reduktionsteilung bei *Solanum tuberosum*. Stows Untersuchungen zeigen, dass bei niedrigen Temperaturen (8°,5—12° C.) die Gemini eine gewisse Tendenz haben, sich zu Gruppen oder Klumpen zusammenzuschliessen, während bei höheren Temperaturen (25°—35°) die Chromosomenkonjugation zum grossen Teil ausbleibt, so dass bi- und univalente Chromosomen gleichzeitig in den heterotypen Metaphasenplatten auftreten. Dazu kommt es bei hoher Temperatur auch vor, dass die homotype Teilung der Chromosomen zu früh eintritt; darauf beruht es, dass Stow bisweilen

sogar mehr als die diploide Zahl in den heterotypen Teilungen fand. Bei etwa 20° C. endlich verläuft die Reduktionsteilung der Kartoffelantheren regelmässig; die einzelnen Kartoffelsorten sind allerdings verschieden wärmeempfindlich.

Stow hat auch bei anderen Pflanzen — *Tradescantia virginica* und *Paris quadrifolia* — ähnliche Beobachtungen wie bei Kartoffeln gemacht (Stow 1927). Ich möchte bei dieser Gelegenheit besonders betonen, dass Stows Arbeiten die ersten sind, die einen Einfluss der Temperatur auf die Konjugation der Chromosomen klar beweisen und exakte Angaben über diesen Einfluss machen.

Ausser den oben erwähnten japanischen Arbeiten sind noch zwei zu nennen, die von Takagi (1928) und Nishiyama (1928). In Takagis kurzer aber wichtiger Arbeit wird bewiesen, dass in den Pollenmutterzellen von *Lychnis Sieboldii* die Reduktionsteilung bei 36° C. noch ganz normal verläuft, während aber bei 38°—39° C. die Chromosomenkonjugation gewöhnlich völlig (bisweilen teilweise) ausbleibt. Die univalenten Chromosomen verhalten sich dann während der meiotischen Teilungen verschieden. In gewissen Fällen wurde, wie bei Stows Kartoffelexperimenten, auch gefunden, dass die homotype Teilung der Chromosomen zu früh einsetzt, so dass in der heterotypen Teilung fast die tetraploide Zahl der Chromosomen beobachtet werden konnte. Nishiyama berichtet über einen Fall, wo bei *Lycoris radiata* zufällig, wahrscheinlich durch hohe Temperatur, die Konjugation der Chromosomen ganz ausgeblieben war.

Ich selbst habe endlich (Heilborn 1928), wie schon oben erwähnt, bei verschiedenen Apfelsorten, unter Einfluss hoher Temperatur, eine beträchtliche Abnahme der Chromosomenkonjugation beobachten können. Da aber meine Beobachtungen recht zufällig gemacht wurden, die Temperatur nicht exakt gemessen und Parallelversuche bei niedriger Temperatur nicht ausgeführt wurden, waren neue Versuche notwendig, um entscheiden zu können, inwieweit bei Äpfeln die Teilungen der Pollenmutterzellen temperaturempfindlich sind. Über solche Versuche wird unten berichtet.

Suchen wir die Ergebnisse der bisherigen Forschungen über Temperatur und Chromosomenkonjugation zusammenzufassen, so ergibt sich folgendes. Bei *Epilobium*- und *Oenothera*-Arten (Michaelis), bei *Liriope graminifolia* und *Scilla japonica* (Shimotomai) rufen niedrige Temperaturen allem Anschein nach eine Schwächung der Chromosomenkonjugation hervor. Bei Kartoffelvarietäten (Stow)

und bei *Lychnis Sieboldii* (Takagi) rufen hohe Temperaturen eine Abnahme der Chromosomenkonjugation hervor, ebenso, allem Anschein nach, auch bei *Gagea lutea* (Sakamura und Stow), Apfelvarietäten (Heilborn) und *Lycoris radiata* (Nishiyama). Die einzelnen Spezies sind offenbar verschieden empfindlich; wenig empfindlich ist z. B. *Lychnis Sieboldii,* viel empfindlicher gewisse Kartoffel- und Apfelsorten. Einzelne Varietäten einer und derselben Spezies sind wahrscheinlich auch verschieden empfindlich.

Thermostatversuche mit Apfelzweigen.

Bei meinen Thermostatversuchen mit Apfelzweigen, von denen schon oben die Rede war, kam ich bald zu der Auffassung, dass es möglich wäre, durch Zählen der univalenten Chromosomen bei verschiedenen Temperaturen den Zusammenhang zwischen Temperatur und Chromosomenkonjugation gewissermässen quantitativ zu fassen. Schon Stow hatte ja einen sehr wichtigen Versuch in diese Richtung gemacht, indem er die optimale Temperatur der Reduktionsteilung bei Kartoffeln zu bestimmen suchte. Meine Zählungen und Berechnungen an Apfel-Chromosomen dürften aber auf dem Wege nach exakter Bestimmung des Temperatureinflusses noch einen weiteren Schritt bedeuten, indem hier den Versuch gemacht wird, die Zahl der univalenten Chromosomen als Mass des Temperatureinflusses zu betrachten. Der Vorteil dieser Betrachtungsweise liegt darin, dass dadurch der Einfluss der Temperatur zahlenmässig ausgedrückt werden kann.

Die Zählung der Chromosomen habe ich teils in Polansichten der heterotypen Metaphasen ausgeführt, teils auch in Polansichten der heterotypen Anaphasen. Es hat sich dabei aber schon früh herausgestellt, dass es notwendig war — um eine einigermassen umfangreiche Statistik zu erhalten — auch die Seitenansichten der heterotypen Anaphasen zu zählen. In den Seitenansichten kann man im allgemeinen nur die bei der Teilung verspäteten univalenten Chromosomen mit einiger Sicherheit zählen. Zwar verspäten sich die meisten Univalenten — indem sie sich während der Metaphase gewöhnlich in die Äquatorialebene eingestellt haben — jedoch wandern oft einige von ihnen nebst den Bivalenten sofort in die Tochterkerne hinein. Die Zahl der Univalenten jeder

Teilung, die man durch Zählen der Seitenansichten der heterotypen Anaphasen erhält, ist somit nur eine Minimumzahl. Schliesslich habe ich auch die homotypen Metaphasen für diesen Zweck benutzt. Wenn man nämlich schon früher die haploide oder somatische Chromosomenzahl der betreffenden Apfelsorte ermittelt hat, kann man durch Zählen beider Platten derselben homotypen Metaphase eine ungefähre Auffassung von der Anzahl univalenter Chromosomen in den vorangegangenen Teilungsstadien erhalten. Durch diese letztgenannte Methode erhält man wieder nur eine Minimumzahl der Univalenten, weil es ja oft eintrifft, dass die Univalenten während der heterotypen Anaphase auf die Tochterkerne annähernd gleich verteilt worden sind; dadurch erhalten die folgenden homotypen Metaphasen trotz der mangelhaften Chromosomenkonjugation doch noch eine etwa normale Chromosomenzahl. Durch Zählen von so vielen heterotypen Meta- und Anaphasen sowie homotypen Metaphasen wie möglich habe ich Mittelwertzahlen erhalten, die zwar alle Minimumziffern sind, jedoch wahrscheinlich nicht weit unter den wahren Mittelwerten liegen.

Der Thermostat, den ich bei meinen Versuchen benutzt habe, besteht aus sechs Kammern, in denen Apfelzweige mit jungen Blütenknospen gleichzeitig bei sechs verschiedenen Temperaturen gehalten werden konnten. Die Temperaturen waren während jeder Versuchsreihe konstant. Dabei waren Licht- und Feuchtigkeitsverhältnisse in allen Kammern gleich. In Versuchsreihe II herrschte konstante, elektrische Beleuchtung, in Versuchsreihen III und IV konstantes Dunkel oder Halbdunkel (keine künstliche Beleuchtung), in Versuchsreihe I wechselte 10-stündige Beleuchtung mit 14-stündigem Dunkel ab. Irgendwelche Bedeutung für die Reduktionsteilung schienen aber diese Verschiedenheiten der Beleuchtung nicht zu haben. Die knospentragenden Zweige wurden im Hortus Bergianus bei Stockholm Mitte Mai eingesammelt und in Gefässe mit Wasser in die Thermostatkammer gestellt. In den Kammern mit hohen Temperaturen (25°—35°) konnten die Knospen schon nach zwei Tagen fixiert werden, in den Kammern mit niedrigen Temperaturen (10°—15°) war ein oft bis 5-tägiges Verweilen in der Thermostatkammer notwendig, um die richtigen Entwicklungsstadien zu erhalten. Sämtliche Fixierungen sind in Nawaschin-Karpechenkos Chromsäure-Essigsäure-Formalinmischung gemacht.

Ich habe vier Versuchsreihen gemacht, zwei im Jahre 1928 und

zwei 1929. Jede Reihe umfasste zwei bis vier Apfelsorten, es ist mir aber nicht in allen Fällen gelungen, die richtigen meiotischen Stadien zu erhalten, was mich veranlasst hat, in der folgenden Darstellung nur über einen Teil des Versuchsmaterials zu berichten.

Versuchsreihe I.

»Sävstaholm». Die Zweige wurden am 7. Mai 1928 in sechs Thermostatkammern gestellt. Es gelang mir aber, geglückte Fixierungen nur von demjenigen Material zu erhalten, das bei 10° C., 30° C. und 35° C. stand.

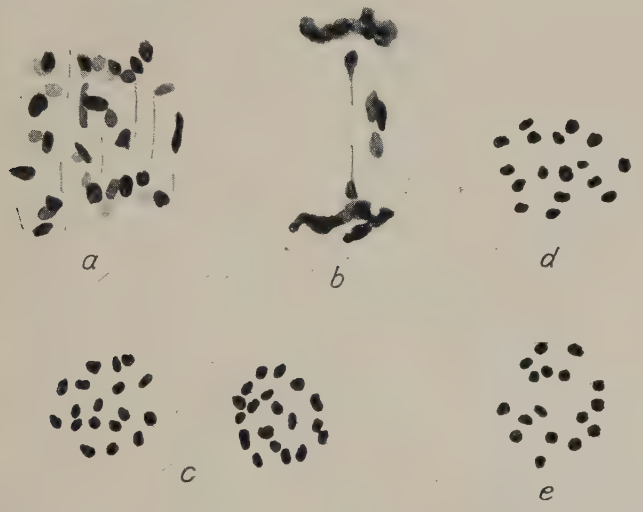

Fig. 1. *a* »Sävstaholm» 35°: heterotypische Meta-Anaphase, Typus B (34_I). *b* »Weisser Astrachan» 20°: heterotypische Ana-Telophase, Typus A, mit 4 verspäteten Chromosomen (also wenigstens 4_I). *c* »Åkerö» 35°: zwei zusammengehörige homotypische Metaphasen mit 18 bzw. 19 Chromosomen (in der vorangegangenen heterotypischen Metaphase also wenigstens 4_I, von denen 3 während der Anaphase längsgeteilt worden sind). *d* »Åkerö» 10°: heterotypische Metaphase (17_{II}). *e* »Cox's Pomona» 10°: heterotypische Metaphase (17_{II}). — Obj. $^1/_{12}$, Ok. 20 ×. — Im übrigen sei auf die Figuren in der vorigen Arbeit (1928) des Verfassers verwiesen.

Das 10°-Material wurde am 12. Mai (also nach 5 Tagen) fixiert. Es ergab sich als völlig normal mit durchweg 17 Gemini in allen heterotypen Teilungen (also 0 Univalente).

Das bei 30° fixierte Material hatte 2 Tage in der Thermostatkammer verbracht und wurde am 9. Mai fixiert. In ziemlich vielen Teilungen konnte ich hier die Anzahl der univalenten Chromosomen bestimmen, wobei es sich herausstellte, dass die

Temperaturerhöhung eine deutliche Wirkung auf die Chromosomenkonjugation ausgeübt hatte. Von 83 gezählten Teilungsfiguren ergaben sich 38 oder beinahe die Hälfte als normal mit vollständiger Chromosomenkonjugation, 37 hatten 2 Univalente, 5 hatten 4, 2 hatten 6 und 1 etwa 14 Univalente. Durchschnittlich fanden sich bei dem 30°-Material etwa 4 % univalente Chromosomen oder etwa 1,4 in jedem Kern.

Das bei 35° fixierte Material wies bedeutende Schwankungen an Unregelmässigkeiten auf. Schon in meiner früheren Apfelstudie habe ich zwei Typen der Temperatureinwirkung auf den Teilungsmechanismus unterscheiden können. Bei Typus A äussert sich die Einwirkung der Temperatur nur in einer Schwächung der Chromosomenkonjugation, die Kernteilungen sind aber sonst recht regelmässig (hierher gehören die allermeisten untersuchten Kernteilungen), bei Typus B findet sich dagegen, ausser der Abnahme der Chromosomenkonjugation, auch eine gewisse Störung der Spindelbildung, so dass die Bildung der Äquatorialplatten völlig ausbleiben kann (über Einzelheiten siehe Heilborn 1928). In dem bei 35° fixierten »Sävstaholmer»-Material habe ich nun wieder einige Fälle von Typus B gefunden, während die meisten Kernteilungen wie gewöhnlich zum Typus A gehörten. Die wenigen Teilungen des Typus B, in denen ich die Chromosomen zählen konnte, zeigten alle völlig ausgebliebene Chromosomenkonjugation und hatten also je 34 univalente Chromosomen. In den Kernteilungen des Typus A, deren leider auch recht wenige waren, fanden sich dagegen nur etwa 0—14 Univalente. Die insgesamt etwa 10 Teilungsfiguren, in denen ich die Chromosomen gezählt habe, ergaben durchschnittlich etwa 35 % univalente Chromosomen oder etwa 12 pro Kern. Diese Ziffern sind zwar nicht ganz exakt, dürften aber wahrscheinlich eine ungefähre Auffassung von der Einwirkung der Temperatur geben. Jedenfalls scheint aus den Zahlen hervorzugehen, dass in dem vorliegenden Falle die Erhöhung der Temperatur von 30° bis 35° C. noch eine weitere Schwächung der Chromosomenkonjugation bewirkt hatte.

Es muss aber ausdrücklich betont werden, dass die Temperatur auf einzelne Staubbeutel oder Knospen sehr verschieden stark wirkte, obgleich alle Zweige desselben Temperaturversuches so ähnlichen Bedingungen, wie es überhaupt möglich war, ausgesetzt worden waren. Über solche Schwankungen der Reaktion auf Temperaturerhöhung habe ich schon in meiner vorigen Arbeit (1928) berichtet,

über die Ursachen dieser Schwankungen wissen wir aber bisjetzt nichts. Dieselben können jedenfalls nicht darauf beruhen, dass die Temperaturerhöhung verschiedene Entwicklungsstadien der Pollenmutterzellen getroffen hat, denn alle Pollenmutterzellen, die

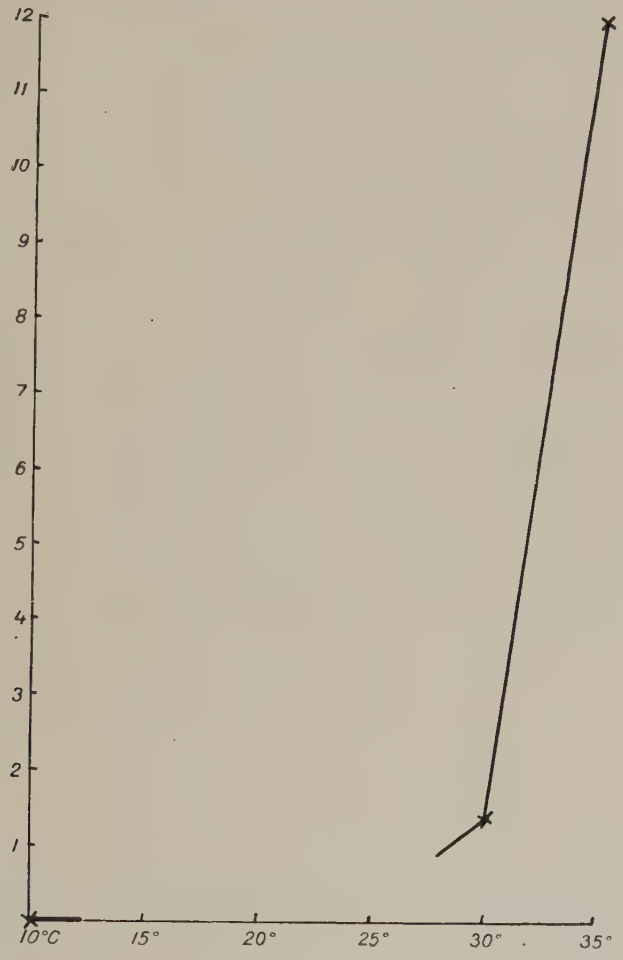

Fig. 2. Anzahl univalenter Chromosomen pro Kern (vertikale Zahlenreihe) in Pollenmutterzellen von »Sävstaholm».

bei der Fixierung sich z. B. in dem heterotypen Metaphasenstadium befanden, haben höchst wahrscheinlich alle mit gleicher Geschwindigkeit ihre frühere Entwicklungsstadien durchlaufen und müssten daher alle im selben Entwicklungsstadium von der Temperaturerhöhung getroffen worden sein. Um nun sichere Durchschnitts-

ziffern zu erhalten und Zufälligkeiten eliminieren zu können, müsste eigentlich ein viel grösseres Material durchgearbeitet werden, als ich es bisjetz habe tun können.

Ich habe den Versuch gemacht, die Ergebnisse meiner Untersuchung graphisch zu veranschaulichen. Die Ziffern, die den Kurven zugrunde liegen, sind zwar — wie aus meiner Darstellung hervorgehen dürfte — von sehr verschiedener Genauigkeit, die Kurven sollen aber nur als eine Art Illustration zu betrachten sein. Fig. 2 stellt die Kurve für »Sävstaholm» dar. Hierzu soll nur noch nachträglich bemerkt werden, dass ich schon früher (1928) über »Sävstaholm» kurz berichtet habe; meine damaligen Angaben dürften durch die oben dargelegten Ergebnisse bestätigt sein.

»Weisser Astrachan». Bei dieser Sorte habe ich 1928 über beträchtliche, wahrscheinlich durch hohe Temperatur hervorgerufene Unregelmässigkeiten berichtet. Nach meinen damaligen Ergebnissen fanden sich an dem untersuchten Warmhausmaterial durchschnittlich etwa 28 univalente Chromosomen pro Kern (über 80 %); dagegen hatten andere Forscher über normale Reduktionsteilung dieser Sorte berichtet (vgl. Heilborn 1928). Meine Thermostatversuche mit »Weissem Astrachan» sind nun aber leider zum grossen Teil misslungen. Die Versuche fingen am 7. Mai 1928 an. Von den Resultaten soll hier nur als besonders interessant hervorgehoben werden, dass ich an Knospen von Zweigen, welche nach 3-tägigem Verweilen in einer 20° Thermostatkammer fixiert worden waren, einen schwachen aber deutlichen Einfluss der Temperatur beobachtet habe. Von etwa 85 gezählten Kernteilungen ergaben sich etwa 70 als normal mit vollständiger Chromosomenkonjugation, in 9 Fällen fanden sich 2 Univalente, in 4 Fällen 4 und in einem Falle 6. Durchschnittlich ergibt sich daraus etwa 1,5 % univalente Chromosomen oder etwa 0,5 pro Kern. Dieses Resultat ist von Interesse, weil es zeigt, dass bei der Sorte »Weisser Astrachan» die kritische Temperatur, wo die schädliche Wirkung anfängt, ziemlich niedrig zu liegen scheint.

Versuchsreihe II.

»Åkerö». Zweige wurden am 14. Mai 1928 in sechs Thermostatkammern gebracht. Von dem Material habe ich die Chromosomen nur in den bei 10° C., 25° C. und 35° C. fixierten Knospen zählen können. Das bei 10° fixierte Material war durchweg normal.

In dem bei 25° fixierten Material fand ich auf etwa 30 normale Teilungsfiguren eine mit 6 univalenten Chromosomen. Daraus würde sich durchschnittlich etwa 0,2 univalente Chromosomen pro Kern oder etwa 0,5 % ergeben. In dem bei 35° fixierten Material habe ich nur 4 Kernteilungen zählen können; davon waren 3

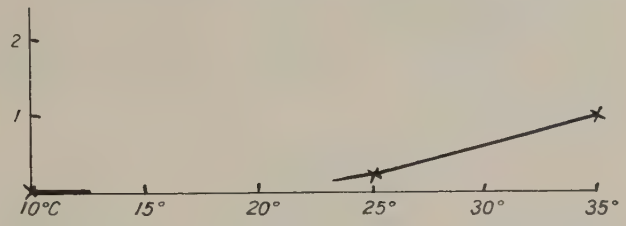

Fig. 3. Anzahl univalenter Chromosomen pro Kern (vertikale Zahlenreihe) in Pollenmutterzellen von »Åkerö».

normal und 1 hatte 4 univalente Chromosomen, was durchschnittlich 1 univalentes Chromosom pro Kern oder etwa 3 % bedeuten würde. Die letztgenannten Ziffern sind selbstverständlich sehr unsicher, jedoch scheint es, als ob »Åkerö» eine deutliche, obwohl sehr schwache Reaktion auf die Temperaturerhöhung gezeigt habe (Fig. 3). Ausserdem zeigte das 35°-Material andere Teilungsanomalien. So war wahrscheinlich eine Art von Lähmung des Teilungsmechanismus stellenweise eingetreten, wodurch in den homotypen Teilungen einige diploide Regressionskerne zu finden waren.

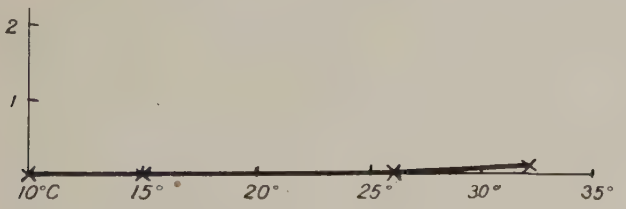

Fig. 4. Anzahl univalenter Chromosomen pro Kern (vertikale Zahlenreihe) in Pollenmutterzellen von »Cox's Pomona».

Versuchsreihen II und III.

»Cox's Pomona». Zweige wurden teils in der Versuchsreihe II vom 14. Mai 1928 an in den Thermostatkammern, teils in Versuchsreihe III vom 13. Mai 1929 an bei vier verschiedenen Temperaturen gehalten. Insgesamt sind Knospen bei 10° C., 15° C., 26° C. und 32° C. fixiert worden. Das 10°- und das 15°-Material

erwies sich als ganz normal. In dem 26°-Material konnte ich an etwa 85 normalen Teilungsfiguren eine einzige mit 2 univalenten Chromosomen auffinden (weniger als 0,1 % oder etwa 0,02 univalente Chromosomen pro Kern). In dem 32°-Material fand ich auf mehr als 60 normale Teilungsfiguren 3 Teilungen mit je 2 univalenten Chromosomen (etwa 0,2 % oder weniger als 0,1 univalente Chromosomen pro Kern). Aus diesen Daten geht hervor, dass »Cox's Pomona» offenbar fast unempfindlich für die Temperaturerhöhung gewesen war (Fig. 4).

Schlussbemerkungen.

Es ist also durch die vorliegende Untersuchung erwiesen, dass die Reduktionsteilung gewisser Apfelsorten für Temperaturerhöhung empfindlich sind, und somit meine schon früher (1928) ausgesprochene Ansicht in dieser Frage bestätigt worden ist. Die hohe Temperatur hat auf die Konjugation der Chromosomen eine spezielle Wirkung, indem bei wärmebehandeltem Material univalente Chromosomen auftreten. Man kann die Anzahl univalenter Chromosomen pro Kern als ein gutes Mass der Wärmeempfindlichkeit der Reduktionsteilung der betreffenden Sorte benutzen.

Aus den hier veröffentlichten Angaben geht auch hervor, dass die einzelnen Apfelsorten für erhöhte Temperatur verschieden empfindlich sind. Das wurde schon früher als Vermutung ausgesprochen: es bietet ja auch eigentlich nichts Überraschendes, dass die einzelnen Sorten verschiedene Temperaturoptima haben. Wärmeempfindlich in der Chromosomenkonjugation sind »Weisser Astrachan» und »Sävstaholm», schwach empfindlich oder fast unempfindlich (bis 35°) sind »Åkerö» und »Cox's Pomona». Bei »Weissem Astrachan» wirkt schon eine so mässige Temperatur wie 20° C. auf die Chromosomenkonjugation schädlich.

In diesem Zusammenhang sei auf eine interessante Erscheinung aufmerksam gemacht. Von den in der vorliegenden Arbeit untersuchten Apfelsorten treten zwei, »Weisser Astrachan» und »Sävstaholm», in das Stadium der Reduktionsteilung etwa eine Woche früher ein als die zwei anderen, »Åkerö» und »Cox's Pomona». Zur Beleuchtung dieser Erscheinung habe ich in dem obigen Bericht die Anfangstage der einzelnen Versuchsreihen angegeben. Die Blütezeiten der einzelnen Sorten sind ebenso um etwa denselben Zeitraum verschieden. Es ist nun von Interesse, dass die beiden

früheren Apfelsorten offenbar für Wärme empfindlicher sind als die beiden späteren. Es dürfte sich also ein Zusammenhang finden zwischen Blütezeit der betreffenden Sorte einerseits, Wärmeempfindlichkeit der Reduktionsteilung andererseits. Darin liegt wieder nichts Überraschendes, denn die Frage nach Temperatur und Chromosomenkonjugation ist gewiss nur ein Teil des grösseren Problems von der Akklimatisation der einzelnen Arten und Gartensorten.

Stockholm, Botanisches Institut der Universität, November 1929.

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ZUR KENNTNIS DER ANATOMIE VON STRYCHNOS TIEUTE.

EIN ANATOMISCHER BEITRAG ZUR HORMONTHEORIE HABERLANDTS.

VON

DANIEL LIHNELL.

Nachstehender Aufsatz stellt einige Ergebnisse einer Studie von der Anatomie von *Strychnos Tieute* Lesch. dar, welche im Frühjahre 1929 in dem botanischen Institut in Uppsala vorgenommen wurde. Das Untersuchungsmaterial bestand aus in Spiritus konservierten jungen Pflanzen vom Botanischen Garten in Buitenzorg (Java), welche dort im Jahre 1903 von Prof. N. Svedelius gesammelt wurden und mir von ihm liebenswürdigerweise zur Verfügung gestellt worden sind. Für die Hilfe und die Leitung bei Ausführung der Arbeit, welche mir seitens Prof. Svedelius zuteil wurden, spreche ich meinen tiefgefühlten Dank aus.

Das Alter der Pflanzen wechselte zwischen einem Monate und zu etwa einem Jahre. Die jüngsten bestanden ausser dem Wurzelsysteme lediglich aus dem etwa 20 cm hohen Hypokotyl mit darauf befindlichen Keimblättern; die ältesten waren etwa 50 cm hoch und hatten vier bis sechs entwickelte Blattpaare.

Meine Absicht war, als pflanzenanatomische Aufgabe die Anatomie im allgemeinen zu untersuchen, indessen veranlassten mich mehrere Ursachen, der Korkbildung und einigen damit zusammenhängenden Fragen ganz besondere Aufmerksamkeit zu widmen.

Die Anatomie dieser Pflanze war bereits in ihren Grundzügen dank einer Untersuchung von Itschert (1894) bekannt. Im grossen ganzen konnte ich die von Itschert erzielten Ergebnisse bestätigen; indessen stimmen unsere Beobachtungen in zwei Punkten nicht

miteinander überein. Es handelte sich hierbei um die Peridermbildung. Itschert widmet dieser Sache zwar kein grösseres Interesse, sagt aber im Vorbeigehen: »Bei dem zweijährigen Holze geht bereits die Korkbildung vor sich, durch Entstehung von braunen, tangential gestreckten, nach aussen etwas gekrümmten Zellen unter der Epidermis — — —.» Was mir dabei besonders auffiel, ist erstens einmal, dass die Korkbildung »bei dem zweijährigen Holze» vorsichgehen soll. So viel ich gefunden habe, tritt sie weit früher ein. Zwar liegen hinsichtlich der Pflanzen, an welchen die Entstehung des Periderms beobachtet werden konnte, keine direkten Aufgaben über das Alter vor, aber bei Vergleich mit anderen, jüngeren Pflanzen, für welche erforderliche Daten bestehen, kann ich mit Sicherheit das Alter der betreffenden Stammteile auf höchstens 1 Jahr schätzen. Dies bezüglich des Zeitpunktes.

Hinsichtlich der Stelle der Entstehung des Phellogens sagt Itschert, die Korkzellen bildeten sich »unter der Epidermis». Das ist ja nun einmal eine höchst schwebende Angabe, welche, genau genommen, bedeuten könnte: irgendwo im Stamme, und zwar ganz besonders, da Itschert keinerlei Bilder zur Veranschaulichung dieses Verhältnisses aufweist. Indessen dünkt es mir, als könne man dies nicht anders auffassen, als dass die Korkbildung unmittelbar unterhalb der Epidermis stattfinde, und zwar in einer der äussersten Schichten der primären Rinde. Anstatt dessen habe ich aber festgestellt, dass die Anlegestelle des Phellogens die zweitinnerste Schicht der primären Rinde ist, demnach diejenige Schicht, welche der um den Zentralzylinder herumliegenden Stärkescheide am nächsten liegt (siehe Fig. 1 *a*, welche frühe Teilungen in dem Phellogen aufweist).

Diese meine Beobachtungen stimmen also mit denen Itscherts nicht überein, weshalb ich dieselbe einer Erwähnung wert halte.

Von grösserem Interesse dürfte die Entstehung des Periderms sein. Den Impuls zu einer näheren Beachtung derselben erhielt ich durch die Abhandlung G. Haberlandts »Zur Entwicklungsphysiologie des Periderms», in welcher er seine bekannte Theorie von Nekrohormonen als Erreger der ersten Teilungen bei Anlegung des Phellogens vertritt. Ohne nun selbst Stellung zu dieser Theorie und deren Bedeutung im allgemeinen zu nehmen, habe ich gleichwohl überall, wo ich bei *Strychnos Tieute* phellogene Teilungen gefunden habe, nachzuforschen versucht, inwieweit

wohl deren erste Anlage als im Zusammenhang mit dem Auftreten einiger Organe, von welchen man die Abscheidung von Nekrohormonen, so wie es die Theorie HABERLANDTS fordert, annehmen könnte, zu verzeichnen ist. Meine Aufgabe bestand darin festzustellen, inwieweit die ersten Teilungen in der Nähe toter oder absterbender Zellen errichtet werden. Das scheint nun tatsächlich der Fall zu sein.

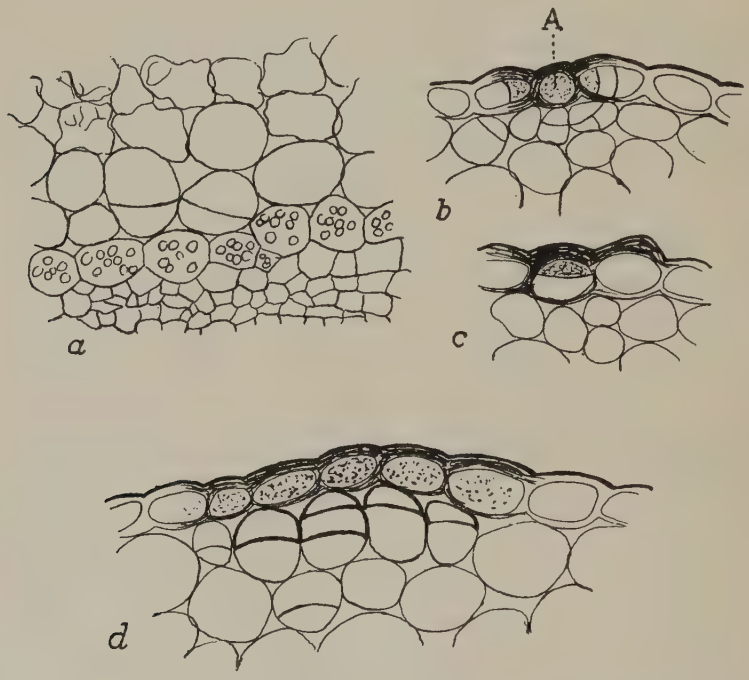

Fig. 1. *a* Querschnitt durch einen etwa 1 Jahr alten Stamm. Die ersten Teilungen im Phellogen. Äusserst zusammengepresstes Rindenparenchym, darauf zwei geteilte Zellen, die Stärkescheide sowie der Perizykel. *b*—*d* Querschnitt durch einen etwa 2 Monate alten Stamm: *b* und *c* beginnende Teilung, *A*, tote Zelle, *d* vorgeschrittenes Stadium mit verkorkten Zellen (durch grobe Linien angedeutet). — Vergr. × 225.

Der Stamm:

Der Stamm zeigt in jüngeren Stadien keine beachtenswerten Eigentümlichkeiten. Innerhalb einer einschichtigen Epidermis folgt die fünf bis sechs Zellenlager enthaltende primäre Rinde, deren innerste Schicht zu einer den Zentralzylinder umschliessende Stärkescheide herausgebildet ist. Schon in dem einen oder einige Monate alten Stamme kann man hier und da an begrenzten

Stellen in den epidermalen und subepidermalen Schichten Teilungsphenomene beobachten. Zu bemerken ist, dass diese immer in der Nähe von Epidermiszellen auftreten, deren Wände stark braunfarbig sind und in welchen der Inhalt als braune, körnige Klumpen unterschieden werden kann, kurz gesagt: Epidermiszellen, welche deutlich den Eindruck machen, gestorben oder im Absterben begriffen zu sein (siehe Fig. 1 *b*, *c*). Nicht ein einziger Fall, wo Teilungen vorgekommen sind, ohne dass in unmittelbarer Nähe solche Zellen gleichzeitig auftraten, konnte festgestellt werden. Demnach liegt es nahe, sich diese absterbenden Epidermiszellen in Übereinstimmung mit der Theorie Haberlandts als Produzenten von Nekrohormonen zu denken, welche in die angrenzenden, frischen Zellen hineindiffundieren und dort Antrieb zu beginnenden Teilungen werden. Die neuen Wände bei diesen Teilungen werden immer in Übereinstimmung mit der Haberlandtschen eingangs seiner bereits erwähnten Abhandlung formulierten »Diffusions- und Anschlussregeln» angelegt. Demnach sehen wir z. B. an Fig. 1 *b*, wie die Wände in der Epidermis antiklin, in den subepidermalen Schichten dagegen mehr oder minder periklin stehen, d. h. in den beiden Fällen winkelrecht zur angenommenen Diffusionsrichtung der in der toten Zelle A (Fig. 1, *b*) etwa gebildeten Nekrohormonen, oder m. a. W. in beiden Fällen in voller Übereinstimmung mit der »Diffusionsregel» Haberlandts. Wenn sich eine Zelle teilt und die in derselben Schicht gelegenen Nachbarzellen sich sukzessiv teilen, verkehren die neuen Wände der »Anschlussregel» gemäss mehr oder minder rege miteinander (siehe Fig. 1 *d*).

Recht bald beginnen die ältesten der neugebildeten Zellen sich zu verkorken. Es kommt jedoch niemals dahin, dass sich ein zusammenhängendes Periderm bildet. Höchstens lokale Anhäufungen von Korkzellen entstehen, welche gewöhnlich mit blossem Auge als braungefärbte Erhöhungen auf der Epidermis unterschieden werden können. Die schliessliche Peridermbildung findet erst später statt und zwar in tiefer gelegenen Zellenlagern. (Vergl. Fig. 1 *a* und das oben Angeführte!)

Eine erste Phase in dem Entwicklungsgange des Periderms besteht darin, dass, als Folge des starken Druckes, welcher von dem sekundär anwachsenden Holzringe auf die herumlagernden Gewebe ausgeübt wird, die mit dünnen Wänden versehenen Parenchymzellen in der primären Rinde hier und da zusammengepresst

werden. Wenn nun der grössere Teil der Rinde auf diese Art mit Ausnahme der inneren Zellenlager zerstört worden ist, beginnt in der zweitinnersten Schicht, demnach der ausserhalb der Stärkescheide am nächsten liegenden, die Bildung perikliner Wände (siehe Fig. 1 *a*). Zu beachten ist, dass die Teilungen zuerst innerhalb derjenigen Gebiete, wo die Zerstörung der Parenchyme am schnellsten und kräftigsten geschieht, eintreten. Vergleiche den Verlauf bei *Ribes aureum* nach Haberlandt (1928, S. 20)! Aus den zuerst geteilten Zellen heraus schreiten die Teilungen der »Anschlussregel» gemäss nach beiden Seiten fort, sodass bald eine zusammenhängende Teilungszone entsteht, von wo aus sich nach aussen hin Korkzellen und nach innen hin Phelloderm abscheiden, letzteres jedoch recht unbedeutend.

Haberlandt will ja auch die Entstehung der Lentizellen als von den Nekrohormonen verursacht hinstellen. Die Verhältnisse bei *Strychnos Tieute* scheinen das ja auch zu bestätigen. Die Lentizellen werden immer unter Spaltöffnungen angelegt (Fig. 2 *a*). Die Schliesszellen (Fig. 2 *a*, S) derselben sterben recht früh, und bald darauf treten in den an die Atemhöhle grenzenden Parenchymzellen lebhafte Teilungen auf, welche allmählich zu einem Korkkambium werden, von wo aus sich nach aussen hin etwas abgerundete Zellen mit verkorkten Wänden abscheiden; die Lentizelle ist fertig. Es erscheint ja recht glaublich, dass etwaige Nekrohormonen von den toten Schliesszellen die auslösenden Faktoren bei diesen Teilungen sind. Vergleiche die Verhältnisse bei *Ptelea trifoliata* in der Abhandlung Haberlandts (1928, S. 10)!

Die Wurzel:

Ähnlich wie in dem Stamme treten auch in der Wurzel oberflächlich gelegene, lokale Korkbildungen auf. Die ersten Teilungen scheinen dabei immer unter Epidermiszellen stattzufinden, welche entweder zerrissen sind (hier wäre also wohl die Rede von der Bildung von Wundkork) oder durch braunfarbigen Inhalt usw. den Eindruck erwecken, im Aussterben begriffen zu sein (Fig. 2 *b*). In beiden Fällen kann man sich ja denken, dass in diesen Zellen Hormonen der einen oder anderen Art gebildet werden, welche nach Passieren der Exodermis, auf welche sie keinen Reiz ausüben zu können scheinen, in den Rindenparenchymzellen als teilungsauslösende Faktoren wirken. Diese oberflächlichen Teilungen werden hier ebenso wenig wie im Stamm Anlass zu einem zusammenhängenden Phellogen, das, wie gewöhnlich bei dikotylen Wurzeln, tiefer, in dem Perizykel, angelegt wird.

Die Verhältnisse hierbei sind analog mit denjenigen im Stamme. Auf Grund des Druckes des Holzringes nach aussen werden die Rindenzellen getötet und zu deformierten Zellenmassen zusammengepresst. Wenn die Zerstörung des Parenchyms das Endodermis

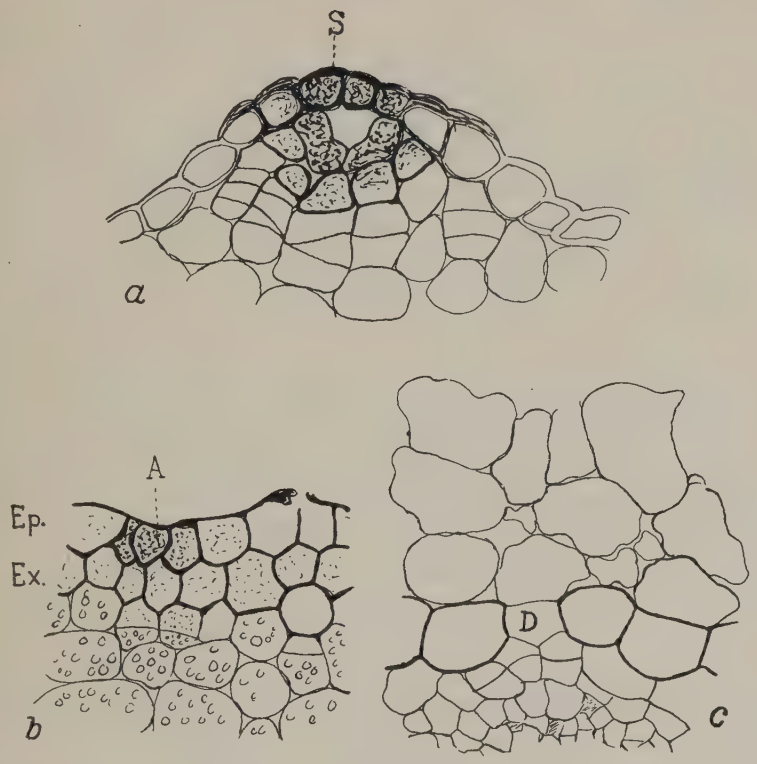

Fig. 2. *a* Stammquerschnitt: die ersten Teilungen in der Lentizelle; S = die tote Spaltöffnung. *b* Wurzelquerschnitt: Teilungen unmittelbar unter der Exodermis; A = abgestorbene Epidermiszellen, Ep. = Epidermis, Ex. = Exodermis. *c* Wurzelquerschnitt: phellogene Teilungen im Perizykel unmittelbar innerhalb einer Durchlasszelle (D). — Vergr. × 225.

erreicht hat, werden die ersten Wände des Phellogens in dem äusseren Lager des Perizykel gebildet und — wohl zu beachten — immer unmittelbar unter den Durchlasszellen (Fig. 2 *c*, D)! Dieser Entwicklungslauf hat sein grosses Interesse, da er deutlich bestätigt, was Haberlandt in dieser Sache vorausgesagt hat. Er hat zwar die Peridermbildung bei Wurzeln nicht untersucht, sagt aber am Schlusse seiner Abhandlung (1928, S. 24) folgendes: »Es ist wohl anzunehmen, dass die in der absterben-

den Wurzelrinde entstehenden Nekrohormone durch die Durchlasszellen der Endodermis in den Pericykel hineindiffundieren. Demgemäss wird man unter diesen Zellen die ersten Teilungen zu erwarten haben.»

Gerade diese Tatsache wird in Fig. 2 *c* veranschaulicht.

Schliesslich eine kurze Zusammanfassung der Resultate, welche meine Untersuchung ergeben hat.

1. Das Phellogen wird bei *Strychnos Tieute* — im Gegensatz zur Angabe Itscherts — in dem einjährigen Stamme und in dem zweitinnersten Lager der Rinde angelegt.

2. Der schliesslichen Peridermbildung gehen Teilungen in den subepidermalen Zellschichten sowohl in der Wurzel als auch im Stamme voran. Diese Teilungen sind jedoch lokalbegrenzten Charakters und geben zu einem zusammenhängenden Korkgewebe keinen Antrieb.

3. Sowohl diese Teilungen als auch diejenigen, welche Anlass zu dem schliesslichen Phellogen geben, werden wahrscheinlich, in Übereinstimmung mit der Theorie Haberlandts, von Nekrohormonen ausgelöst. In jedem Falle können immer tote Zellen unmittelbar ausserhalb derjenigen Punkte, wo die ersten Teilungen entstehen, beobachtet werden.

4. Dies scheint auch mit den ersten Teilungen bei den Lentizellen der Fall zu sein.

5. Eine Untersuchung von der Peridermbildung in der Wurzel hat gezeigt, dass sie unmittelbar innerhalb der Durchlasszellen beginnt, von welchen angenommen werden kann, dass sie Passagen für etwaige Hormonen des absterbenden Rindenparenchyms sind. Der Entwicklungslauf zeigt demnach volle Übereinstimmung mit dem, was Haberlandt hinsichtlich dieser Sache in Aussicht gestellt hat.

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PAPAVER NUDICAULE L. UND EINIGE VERWANDTE ASIATISCHE PAPAVER-FORMEN.

VON

A. TOLMATCHEW.

Die Vielgestaltigkeit der meistens einfach als *Papaver nudicaule* bezeichneten sibirischen und mittelasiatischen *Papaver*-Formen ist seit langem bekannt. Eine moderne Übersicht derselben fehlt indessen immer noch. Wir kennen nicht die tatsächliche Artenanzahl innerhalb der *Nudicaule*-Gruppe, die wohl nicht einmal als eine Sammelart betrachtet werden kann. Es ist nicht einmal klargestellt, was für eine Pflanze wir als das echte *P. nudicaule* zu betrachten haben.

Sowohl Fedde (1909) als Monograph wie Busch (1913) als Verfasser des betreffenden Teiles der »Flora Sibiriae» haben die ganze Formenreihe als eine Art *P. nudicaule* zusammengefasst, von der sie doch verschiedene »Formen», »Varietäten» usw. unterscheiden. Die schon längst als selbständige Arten beschriebenen *P. radicatum* Rottb., *P. microcarpum* DC., *P. croceum* Ledeb. wurden von ihnen nur als Formen der Sammelart *P. nudicaule* behandelt. Dass Fedde *P. nudicaule* einen so grossen Umfang gibt, ist besonders auffallend, weil er die europäischen Vertreter der Sect. *Scapiflora* auf mehrere, viel engere und schärfer umschriebene Arten verteilt. Dass auch die asiatische Formenreihe in mehrere Arten zerfällt, hat in letzter Zeit vor allem Lundström (1923) hervorgehoben. Obgleich er nur ein sehr beschränktes Material zur Verfügung hatte, kam er jedoch zur Schlussfolgerung, dass wir unter den südsibirischen *Papaver*-Formen mehrere Arten unterscheiden müssen. Die Systematik der *Nudicaule*-Gruppe wirk-

lich klarzustellen, hat auch Lundström nicht versucht. Es ist überhaupt zweifelhaft, ob eine endgültige Klarstellung ohne Berücksichtigung der reichen Materialien russischer Herbarien möglich ist. Auch im übrigen stossen wir auf grosse Schwierigkeiten. Einerseits begegnen wir einer ganzen Reihe von noch unbeschriebenen Formen, die man bis jetzt ohne nähere Prüfung zu der einen oder anderen *Nudicaule*-»Form» gezählt hat. Anderseits ist die Vorstellung vom typischen *P. nudicaule* oft sehr subjektiv. Wenn z. B. Lundström (1914, 1923) und ich selbst (1923, 1927) zu ganz verschiedenen Auffassungen über die Grenzen zwischen *P. radicatum* Rottb. und *P. nudicaule* L. gekommen sind, so hängt dies wahrscheinlich mit der Tatsache zusammen, dass wir uns beide hauptsächlich mit den hochnordischen *Papaver*-Formen beschäftigten, welche meiner Ansicht nach alle zu *P. radicatum* gehören, ohne mit dem echten südsibirischen *P. nudicaule* in Berührung zu kommen. Aber auch dieses muss ebenso genau geprüft werden.

Es ist zweifellos anzunehmen, dass Linné (1753) mit seinem *P. nudicaule* eine bestimmte südsibirische Form vor Augen gehabt hat und nicht alle jene Formen, die später von verschiedenen Autoren unter ein und demselben Namen zusammengefasst worden sind. Die meisten von diesen waren ihm sicher unbekannt. Man kann sogar mit grösster Wahrscheinlichkeit annehmen, dass Linnés *P. nudicaule* derjenigen Form entspricht, die Turczaninow (1842) als *P. nudicaule* ssp. *commune* beschrieb. Diese Form ist in Südsibirien, von Tomsk bis nach Transbaikalien, als eine ziemlich häufige Pflanze verbreitet. Obgleich mehrere sehr nahe verwandte Formen vorkommen, lässt sie sich stets leicht von diesen unterscheiden. Da wir sie als typisches *P. nudicaule* L. betrachten, halten wir es für zweckmässig, sie möglichst genau zu beschreiben, um allen künftigen Missverständnissen vorzubeugen.

Papaver nudicaule L. ssp. *commune* Turcz. (Fig. 1.)

Pflanze zumeist zweijährig, in kleinen Polstern wachsend. Bei perennierenden Individuen finden sich — wie bei anderen Arten der Sektion — an der Stengelbasis Reste vorjähriger Blattstiele.

Blattform. Stiel mehr oder weniger lang, meist mindestens ebenso lang wie die Blattspreite, ziemlich breit. Blattspreite stark gegliedert; Anzahl der Blattlappen bedeutenden Schwankungen unter-

Fig. 1. *Papaver nudicaule* ssp. *commune* Turcz. Exemplar aus der Umgebung von Irkutsk (leg. T. Jurinsky).

worfen. Oberhalb des ersten Lappenpaares ist die Spreite gewöhnlich stark verengt; bei weiterer Gliederung wird die Verengung schwächer oder kaum bemerkbar. Das unterste Lappenpaar wird dadurch oft von den übrigen etwas entfernt. Die Lappengrösse nimmt gegen die Blattspitze allmählich ab. Einzelne Lappen sind ihrerseits im unteren Teil der Spreite geteilt; die Läppchen oft nur angedeutet und ohne eigentliche Selbständigkeit. Die die Läppchen abgrenzenden Einschnitte zumeist nicht tief, Innenrand des Läppchens im Winkel etwas konkav, Aussenrand fast gerade; Einschnitte bisweilen fast

rechtwinkelig. Die Spitzen der Lappen und Läppchen sowie diejenigen der ganzen Blattspreite zugespitzt oder abgestumpft. Lappen und Läppchen überhaupt breit und von der Basis bis zur Spitze im grossen und ganzen gleichbreit, ohne Einschnürung an der Basis. Eine durch die Spitzen der Lappen gezogene Linie schliesst eine ovale Fläche ein, die meist kaum doppelt so lang als breit ist.

Blattbehaarung. Blattstiel und zum Teil auch Blattspreite (hauptsächlich auf der Unterseite und ganz besonders am Mittelnerv) dicht mit kräftigen, abstehenden, hellen Haaren bedeckt (an der Oberseite der Spreite ist die Behaarung dünner und stärker angedrückt). Jüngere Blätter dichter behaart als ältere.

Blütenstiel mehr oder weniger kräftig entwickelt, von der Gesamtgrösse der Pflanze abhängig, im grossen und ganzen aber ziemlich dick, bei gut entwickelten Individuen meist 30—40 cm lang, in seiner ganzen Länge mit aufrechten groben, hellen, unterhalb der Blüte bisweilen schwach rötlichen Haaren gleichmässig und ziemlich dicht behaart.

Blüten. Knospen rundlich oder kurz elliptisch. Kelchblätter ziemlich dicht behaart mit weisslichen oder hell-rötlichen, stark abstehenden Borsten. Blütenkrone gross — Kronblätter bis 3 cm lang — seicht becherförmig, in zusammengepresstem Zustand von abgerundet-viereckiger Form mit kleinen (oder ohne) Lücken zwischen den Kronblättern. Diese breit verkehrt-oval, ihre Seitenränder ziemlich scharf in den zumeist schwach welligen Vorderrand übergehend, zumeist gelb, bisweilen weiss, selten rötlich-orange. Staubblätter sehr zahlreich, den Fruchtknoten erheblich überragend.

Kapsel ausgezogen, verkehrt-eiförmig, von ziemlich unbedeutender Grösse, mit hellen, fast angedrückten Borsten mehr oder weniger dicht bedeckt oder ganz kahl. ¦

Die soeben beschriebene Pflanze, die wir meiner Ansicht nach als Typus des *P. nudicaule* L. (*P. nudicaule* ssp. *commune* Turcz.) zu betrachten haben, kommt in Südsibirien (von Tomsk im Westen bis nach Transbaikalien im Osten) nicht selten vor. Sehr nahe verwandt ist das im Amurlande heimische *P. nudicaule* ssp. *amurense* N. Busch, das besonders durch höheren Wuchs, breitere und weniger zerteilte Blätter abweicht. Es lässt sich indessen leicht feststellen, dass mehrere andere Formen, die als *P. nudicaule* figurieren, mit dem oben beschriebenen Typus allzu wenige gemeinsame Merkmale aufweisen. In der Tat sind diese letzteren

keine Artenmerkmale, sondern Eigenschaften, welche der ganzen Sektion *Scapiflora* zukommen und deshalb für die Abgrenzung von einzelnen Arten unbrauchbar sind.

Da die Vertreter der *Nudicaule*-Gruppe unter ziemlich verschiedenen Lebensbedingungen vorkommen können, müssen wir solche Umstände bei der Bewertung morphologischer Unterschiede berücksichtigen. Besonders betreffs der Blattform bedeutet der Zergliederungstypus der Spreite viel mehr als der Zergliederungsgrad derselben. Als für *P. nudicaule* (s. str.) besonders charakteristische Merkmale des Blattes können wir folgende hervorheben: Verhältnismässig grosse Breite der Gesamtspreite und der Blattlappen; Konstanz der Lappenbreite, etwas auswärtsgebogenen Charakter der Lappen und Fehlen einer Einschnürung an ihrer Basis; breite Form der die Läppchen abgrenzenden Einschnitte.

Von den nicht wenigen *Papaver*-Formen, die man meiner Ansicht nach nicht gut mit *P. nudicaule* L. vereinigen kann, werde ich unten nur einige behandeln, die besonders leicht von dem oben beschriebenen Typus zu unterscheiden sind, und die teilweise zu den weitverbreitetsten Vertretern der gesamten Sektion gehören. Nähere Verwandte des arktischen *P. radicatum* Rottb. werden hier nicht behandelt.

Papaver rubro-aurantiacum (Fisch.) E. Lundstr.

Mit vollem Recht betrachtet Lundström (1923) die niedrige orangeblühende Mohnform, die im südlichen Transbaikalien vorkommt, als selbständige Art, obgleich seine Behauptung, dass eine orangeblühende Form von *P. nudicaule* (s. str.) nicht vorkommt, nicht zutreffend ist. Das von ihm als eigene Art abgetrennte *P. rubro-aurantiacum* unterscheidet sich ausser durch die stets orangefärbigen Blüten auch deutlich durch die Blattform (schmale abgestumpfte Lappen), feinere Behaarung, kleine Dimensionen der gesamten Pflanze usw. Gleichzeitig nähert sich *P. rubro-aurantiacum* durch gewisse Merkmale, wie helle Behaarung der Kelchblätter und des Blütenstieles, die abgerundeten Blütenknospen und teilweise auch die Zergliederungsweise der Blätter, gerade *P. nudicaule* und nicht anderen Formen von übereinstimmender Blütenfarbe. Weder die niedrigen Formenkreise vom Typus des *P. microcarpum* DC. noch die grösseren weiter südlich vorkommenden Pflanzen, z. B. *P.* (*nudicaule* ssp.)

corydalifolium (Fedde) oder *P.* (*nudicaule* ssp.) *chinense* (Rgl.) zeigen irgendwelche grössere Ähnlichkeit mit *P. rubro-aurantiacum.*

Die von Lundström gegebene Beschreibung fusst zweifellos auf der im Süden Transbaikaliens verbreiteten Form, die Fedde als *P. nudicaule* ssp. *rubro-aurantiacum* var. *typicum* beschrieben hat. Dieses betrachten wir als den Typus der Art.

Fig. 2. *Papaver rubro-aurantiacum* ssp. *typicum* (Fedde) A. Tolm. Exemplar aus der Umgebung von Tschita (leg. Blagowestschensky & Poplawska, 24. V. 1909).

P. rubro-aurantiacum (Fisch.) E. Lundstr. ssp. *typicum* (Fedde) A. Tolm. nov. comb.

Folia pinnatifida vel bipinnatifida, lobis angustis oblongo-linearibus obtusis vel acutiusculis plerumque seta terminatis, canescenti-hirsuta 3—9 cm longa. Scapi erecti interdum pilis adpressis canescentibus dense vestiti 10—22 (rarius usque 30) cm alti. Alabastra subglobosa, sepala obscura pilis albescenti-rufescentibus quam sepala semper pallidioribus obtecta. Petala late obovata vel subrotunda aurantiaca basi flavescentia 14—20 mm longa. Stamina numerosissima. Capsula oblongo-obovata hispida.

Habitat in parte meridionali Transbaicaliae et in Mongolia septentrionali.

Transbaikalien. Umgebung von Tschita (Blagowestschensky u. Poplawska, Slatkowsky, Tyshnowa, Stefan, Wassiliewa); Station Karymskaja, Kreis Tschita (Nowopokrowsky); am Fl. Nikischicha, Kr. Tschita (Samoschnikow); am Fl. Kutschiger, Kr.

Tschita (Krjukow); Unterlauf des Tugnuj, Kr. Werchneudinsk (Trofimowa); Umgebung von Troizkossawsk (Ikonnikow-Galitzky).

Mongolei. Tal des Kärulen (Kaschkarow); Berg Bogdo-Ola bei Urga (Pawlow, Gorbunowa); Berg Tschingiltä bei Urga (Pawlow); am Fl. Urtu-Tamir (Ikonnikow-Galitzky); Iche-Modo Schlucht im Hangai-Gebirge (Gussew); Felsen bei Tschoiren, Gobe (Kondratjew).

Sehr ähnliche Pflanzen kommen auch im Bezirk Nertschinsk, sowie in den nördlichen Teilen Transbaikaliens, im Witin-Becken, vor. Sie unterscheiden sich vom typischen *P. rubro-aurantiacum* nur durch dünnere borstige Behaarung der Blätter und abstehende kräftigere Haare am Blütenstiel. Wenn auch die erwähnten Merkmale vom morphologischen Gesichtspunkt aus unbedeutend sind, so gehören die betreffenden Formen durchaus einem bestimmten geographischen Gebiet an und wir sind daher berechtigt, eine besondere Unterart aufzustellen.

P. rubro-aurantiacum ssp. ***setosum*** A. Tolm. nov. ssp.

Folia pinnatifida vel bipinnatifida, petiolo abbreviato, lobis oblongo-linearibus obtusiusculis semper seta terminatis, pallide setoso-hirsuta. Scapi erecti interdum setis pallidis (supra pallide rufescentibus) patentibus hirsuti. Alabastra ovoideo-globosa rufescenti-pilosa. Caetera ut in *P. rubro-aurantiaco* ssp. *typico*.

Habitat in Transbaicalia orientali et septentrionali.

Kreis Nertschinsk: bei Sretensk (Blagowestschensky u. Poplawska); bei Nertschinsk (Karo, Sensinow); Sarentuj (Wagner); Agita (Pachomow). Kreis Tschita: am Fl. Nertscha (Syrjanow). Kreis Werchneudinsk: Umgebung von Ukyr (Krjukow, Dwornikow). — Kreis Bargusin, Witim-Becken: am Fl. Ingur (Kabanow, Ssisyj); Endaginskoje (Hutow); bei Polowzew-Winterung (Zarygin).

Wir betrachten somit *P. rubro-aurantiacum* (Fisch.) E. Lundstr. als eine selbständige Art, die in zwei geographische Rassen (Subspecies) mit angrenzenden Arealen zerfällt. Das von Lundström beschriebene *P. rubro-aurantiacum* ssp. *Langeanum* aus Grönland scheint dagegen systematisch entfernter zu sein und zu verdienen, als selbständige Art ausgeschieden zu werden. Neben die beiden oben beschriebenen Formen kann es jedenfalls nicht gestellt werden.

Fig. 3. *Papaver tenellum* (Korsh.) A. Tolm. Exemplar aus dem Karkaraly-Gebirge (leg. S. Korshinsky, VI. 1890).

Papaver tenellum (Korsh.) A. Tolm. nov. spec.

P. alpinum var. *tenellum* Korshinsky in sched. Herb. Acad. Sc. Petrop.

Perenne (?) laxe caespitosum. Folia pinnatifida longe petiolata usque 15 cm longa, segmentis valde distantibus, lobis lanceolatis basi angustatis integris (rarissime incisis) acutiusculis, glaberrima, juniora ± albescenti-pilosa. Scapi erecti tenues 15—30 cm alti pilis tenuissimis adpressis albidis laxe obtecti, in parte inferiore subnudi. Alabastra subglobosa pilosiuscula. Corolla parva; petala late obovata 11—15 mm longa alba basi flavescentia, rarissime flava. Capsula parva dolioliformi-ellipsoidea parum hirsuta.

Fig. 4. *Papaver nivale* A. Tolm. Exemplar aus dem Tukulan-Tal (leg. S. Nedrigailow, 24. VII. 1925).

Habitat in montibus Karkaraly terrae Kirgisorum.

Karkaraly-Gebirge, in schattigen Schluchten, 18—20. VI. 1890 (Korshinsky); dunkle und feuchte Schluchten im Karkaraly-Hochlande, VII. 1843 (A. Schrenk); in den Karkaraly-Gebirgen, V. 1843 (A. Schrenk); Kysyl-Raj-Berge, Bezirk Karkaraly, V. 1914 (Kutscherovskaja).

Nach seinen morphologischen Merkmalen ist *P. tenellum* eine der eigenartigsten und freistehendsten Formen der ganzen Sektion

Scapiflora. Betreffs seiner verwandtschaftlichen Beziehungen wage ich keine bestimmten Sehlussfolgerungen zu ziehen. Zu seiner Verbreitung schliesst es sich wahrscheinlich am ehesten *P. nudicaule* an. Wir verfügen indessen nicht über genügende Tatsachen zur Entscheidung dieser Fragen.

Papaver nivale A. Tolm.

Perenne, caespitosum. Folia bipinnatifida 5—10 cm longa petiolata, petiolo tenuissimo, segmentis valde distantibus lobis lobulisque basi angustatis anguste ovalibus obtusiusculis, pilis brevibus adpressis laxe obtecta. Scapi erecti vel supra parum curvati 14—20 cm alti laxe pilosi vel subnudi, pilis obscuris. Alabastra elliptica, sepala ± dense brunneo-pilosa. Petala flava (in sicco viridescentia) late obovata 17—20 mm longa. Capsula oblongo-obovata brunneo-hispida.

Habitat in jugo montium Werchojanicorum (Werchojanskij Chrebet) Jacutiae.

Werchojanski-Gebirge, im Tal des Tukulan, 914—977 m ü. d. M., 24. VII. 1925 (Nedrigailow); am Fl. Dyby, 14. VII. 1891 (I. u. M. Czersky).

Diese interessante Pflanze erinnert habituell an einige Formen von *P. radicatum* Rottb., dem sie sich tatsächlich betreffs Blütenfarbe, Beschaffenheit und Farbe der Behaarung des Blütenstieles und insbesondere der Kelchblätter nähert. Um so auffallender sind die scharfen Unterschiede gegenüber *P. radicatum* in der Ausbildung der Blätter, die Merkmale zeigt, welche nicht nur dieser Art, sondern auch allen anderen asiatischen Arten der Sektion fremd sind. Durch diese Merkmale schliesst sich *P. nivale* dem mitteleuropäischen *P. alpinum* an und ist wahrscheinlich in die Nähe dieser Art zu stellen. Da aber das vorhandene Material nur spärlich ist und ausserdem aus einer Gegend stammt, die fast vollständig unerforscht ist, lassen sich keine sicheren Schlüsse betreffs der Verwandtschaft von *P. nivale* ziehen. Gleichzeitig spricht sein Vorhandensein für das grosse Interesse, das die Bergketten von Jakutien dem Botaniker darbieten müssen.

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ZYTOLOGISCHE BEOBACHTUNGEN AN S. G. SPELTOIDHETEROZYGOTEN BEIM WEIZEN.

VON

ARTUR HÅKANSSON.

Sowohl in reinen Linien von *Triticum vulgare* als nach Kreuzung dieser Art mit anderen hexaploiden Typen entstehen bisweilen durch »Mutation» Pflanzen, die in mehreren Eigenschaften von *vulgare* abweichen. Weil sie in bezug auf Lockerheit der Ähre und Begrannung *T. Spelta* ähneln, wurden sie Speltoiden genannt. Zuerst erscheinen grannenlose Speltoidheterozygoten, die inkonstant sind, indem sie Normalpflanzen, Heterozygoten und begrannte, konstante Speltoidhomozygoten abspalten.

Die Genetik der Speltoiden ist viel studiert, denn sie bietet viel von Interesse. Verschiedene Speltoidheterozygoten zeigen verschiedene Spaltung, Nilsson-Ehle unterscheidet drei Speltoidtypen, A, B und C. Die Spaltung der Heterozygoten der A-Reihen kann sich dem Normalschema 1 : 2 : 1 mehr oder weniger nähern, sie geben aber zu wenig oder gar keine Speltoidhomozygoten, wie Nilsson-Ehle gezeigt hat, weil die Pollenzellen, die die Speltoidgene tragen, nicht fungieren, wenigstens grösstenteils eliminiert werden. Dies hat auch die Folge, dass das Zahlenverhältnis Normaltypus: Heterozygot sich 1 : 1 statt 1 : 2 nähern kann. Die B-Reihen sind dadurch gekennzeichnet, dass weit mehr Heterozygoten als erwartet abgespaltet werden, Normalpflanzen : Heterozygoten kommen im Verhältnis 1 : 4 bis 1 : 5 vor, Speltoidhomozygoten sind schwächlich und sehr selten. In den C-Reihen schliesslich werden mehr Normalpflanzen als Heterozygoten abgespaltet, der Überschuss an Normalpflanzen ist aber offenbar vielfach klein, so dass das Zahlenverhältnis 1 : 1 nahe kommt, die Grenze zwischen A- und C-Reihen

erscheint also unscharf. Homozygoten sind auch in der C-Reihe selten und schwächlich. Die Spaltung der B- und C-Reihen kann nicht durch eine blosse Elimination von Pollenzellen erklärt werden, andere Komplikationen müssen hier nach Nilsson-Ehle vorhanden sein. Die Reihen sind also nach der Spaltung der Heterozygoten aufgestellt.

Die Speltoiden wurden zuerst von Winge zytologisch untersucht, der das Material von Lindhard bearbeitete (Winge 1924). Die Speltoidheterozygoten hatten dieselbe Chromosomenzahl wie *vulgare*, die Konjugation der Chromosomen war aber oft abweichend. In der Metaphase der ersten Reifeteilung in den Pollenmutterzellen sah man nämlich oft statt 21_{II} — eine Anordnung, die allerdings in den meisten Zellen vorhanden war — $1_{III} + 19_{II} + 1_{I}$. Dies deutete darauf hin, dass die Heterozygoten einen veränderten Chromosomenbestand hatten, ein Chromosom (C-Chromosom wurde es von Winge genannt) war verloren gegangen und durch ein s. g. B-Chromosom ersetzt: während also *vulgare* zwei B- und zwei C-Chromosomen besitzt, müssen die Speltoidheterozygoten drei B- und ein C-Chromosom haben. Die Speltoidheterozygoten entstanden nach Winge, wenn in *vulgare* ausnahmsweise B- mit C-Chromosomen konjugieren. Dann kann nämlich Gameten mit zwei B-Chromosomen aber ohne C-Chromosom gebildet werden, die nach Verschmelzung mit einer normalen Gamete einen Heterozygot bilden. Eine Lösung der Speltoidprobleme auf Grund seiner zytologischen Beobachtungen wurde von Winge versucht. Ekstrand hat die Speltoiden von A-, B- und C-Typus aus dem Material von Nilsson-Ehle vorläufig untersucht, aber keine Abweichungen weder in bezug auf Zahl oder Verhalten ihrer Chromosomen gefunden (nach Nilsson-Ehle 1927, S. 377). Huskins dagegen, der die Speltoidtypen von Nilsson-Ehle und Åkerman untersuchte, hat gefunden, sowohl dass die Speltoiden von normalem *vulgare* zytologisch verschieden sind, wie dass Verschiedenheiten analog denen, die er bei »Fatuoidmutationen» von *Avena sativa* gefunden hat, zwischen den drei Reihen vorhanden sind (Huskins 1928). An den Heterozygoten der A-Reihen wurden ähnliche zytologische Beobachtungen gemacht, wie Winge betreffs Lindhards Material beschrieben hatte, die Heterozygoten der B-Reihen hatten aber nur 41 Chromosomen, die vom C-Typus hatten 43 Chromosomen. Ausgespaltene Homozygoten der letzteren Reihe hatten 44 Chromosomen. Huskins schliesst sich Winge an betreffs der Ursache der Bildung der Speltoiden, die B-Heterozygoten haben

also zwei B- und ein C-Chromosom, die C-Heterozygoten drei B- und zwei C-Chromosomen. Überschuss an B- über C-Chromosomen bedingt nämlich das Hervortreten der Speltoideigenschaften, die verschiedene Chromosomenzahl bedingt die verschiedene Spaltung der Reihen. Soeben erschien die Abhandlung von Vasiljev (Vasiljev 1929), der ein Speltoidtypus von Philiptschenko, der nach seiner Spaltung der C-Reihe anhören soll, untersuchte. Hier waren aber 41 Chromosomen im Heterozygot, 40 im Homozygot vorhanden; er sollte also zytologisch mit den B-Reihen übereinstimmen.

Herr Doktor Åke Åkerman wünschte, dass die Zytologie einiger seiner Speltoiden ausführlich studiert werden sollte, und zwar blind, so dass erst nachdem die Zytologie klargelegt war, mitgeteilt wurde, welche Typen untersucht waren, und erbot mir freundlichst die Untersuchung. Die verschiedenen Angaben in der Literatur, die grosse Mühe, die auf die Klärung der Genetik der Speltoiden verwendet ist, die zum Auffinden so vieler Eigentümlichkeiten geführt hat, berechtigen neue zytologische Untersuchungen. Die zytologischen Daten, die genetische Verhältnisse erklären sollen, müssen so sicher wie möglich konstatiert sein, damit die fortgesetzte Forschung nicht in ein falsches Gleis einrangiert wird. Bei einem Besuch in Svalöv holte ich Speltoidmaterial, das ich später in Lund fixierte. Als Fixiermittel wurde eine vielleicht früher nicht geprüfte Kombination verwendet, indem Ährchen oder Antheren zuerst ein paar Minuten in Carnoys Alkohol-Eisessig-Chloroform gelegt und dann in die nach Allen modifizierte Bouin-Lösung überführt wurden, wo das Material einige Tage verweilen kann. So weit ich urteilen darf, fiel diese Fixierung gut aus. Sie schien besser als Carnoy + Zenker, Carnoy + die erste Mischung von La Cour (auch ein gutes Fixiermittel) oder Carnoy + Flemming (= die Methode Kihara). Die Präparate wurden meist nach der Gentianaviolett-Färbung von Newton behandelt.

Meine Studien über die Zytologie der Speltoiden sind keineswegs abgeschlossen, und ich werde sie fortsetzen. Bei einigen Typen sind die Verhältnisse nicht besonders klar, und ihnen müssen weitere Studien gewidmet werden, ich will aber schon jetzt meine Befunde an einigen anderen publizieren. Dank der Freundlichkeit von Doktor Arne Müntzing in Landskrona konnte ich meine Studien komplettieren. Er hat viel Material aus den Kulturen Nilsson-Ehles nach der Methode von Kihara fixiert, und dies mir überlassen, die Zytologie der von ihm fixierten B-Heterozygoten teile

ich hier mit. Die Figuren zeigen, wenn nichts anderes erwähnt ist, eine ungefähr 2 000-fache Vergrösserung. Es sei erwähnt, dass nur selten in längsgeschnittenen Kernteilungsfiguren alle im Schnitte beobachteten Chromosomen eingezeichnet sind, damit die wesentlichen Züge besser hervortreten. Die Fixierungen aus den Kulturen Åkermans stammen aus dem Jahre 1929, die aus denen Nilsson-Ehles von 1928.

Zuerst soll hervorgehoben werden, dass in untersuchten Normalpflanzen die Chromosomenzahl unverändert war, aber bisweilen doch Störungen in der Reduktionsteilung vorkommen. So wurde in einer Pflanze von 415: 15 von Åkerman Nichtkonjugieren betreffs eines Chromosompaares bisweilen beobachtet, so dass zwei Univalente vorhanden waren (Fig. 1). Eine solche Störung kann wohl zur Bildung einer Gamete mit 22 Chromosomen führen, und dadurch die Entstehung von 43-chromosomigen Pflanzen veranlassen. Die Anaphase war in dieser Pflanze oft unregelmässig, indem Chromosomen verspätet waren; Längsteilung von Univalenten, deren Hälften dann nach verschiedenen Polen der Kernspindel gelangten, kam unter anderem vor.

Unter den untersuchten Speltoidlinien aus den Kulturen Åkermans wurden zwei gefunden, deren Heterozygoten, nämlich 418: 2 und 421: 4, 41 Chromosomen hatten, die erstgenannte ist schon von Huskins untersucht. Beide gehören nach Åkerman zu typischen B-Reihen, und meine Resultate stimmen mit denen Huskins' überein.

In der Metaphase der ersten Reifeteilung war die Chromosomenanordnung beinahe immer $20_{II} + 1_{I}$, sie wurde auch in der Embryosackmutterzelle konstatiert (Fig. 2 *a* und *b*). Einige Male war ein Trivalent vorhanden (Fig 9), das C-Chromosom hatte hier mit den beiden B-Chromosomen konjugiert. In den Heterozygoten vom A-Typus paart sich ja nach Winge und Huskins das C-Chromosom sehr oft mit einem der drei B-Chromosomen, das Auftreten von einem Trivalent in B-Heterozygoten ist also nicht überraschend, eher könnte man es öfter erwarten. Einmal war ein Trivalent und zwei Univalente zu sehen, eine abweichende Paarung kann also auch betreffs anderer Chromosomen eintreffen. Die beobachteten Trivalente bestanden aus drei in einer Reihe liegenden Chromosomen. Die bivalenten Chromosomen sehen in der Metakinese — mit diesem Namen kann man mit Wassermann und

Bělař die Einordnung der nach Auflösung der Kernmembran in der Zelle zerstreuten Chromosomen zu einer Äquatorialplatte bezeichnen — und zu Anfang der Metaphase meist wie Ringe aus, mehrere pflegen ein oder zwei Querarme haben (»Ringe mit terminalem

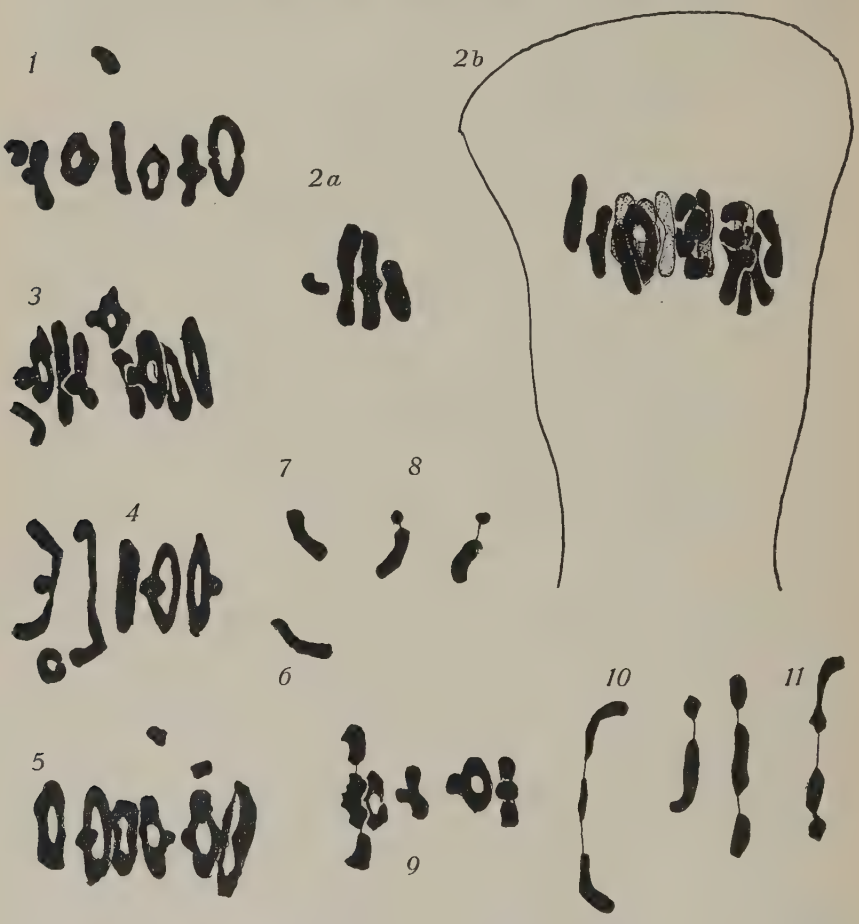

Fig. 1—11. — *1:* Nichtkonjugieren in einer Normalpflanze. — *2—5:* Metaphase der ersten Reifeteilung von B-Heterozygoten. — *6—8:* Univalente, *9:* Trivalent, *10—11:* Bivalente mit Einschnürungen von B-Heterozygoten.

Kreuz»). Später sind oft einige Bivalente sehr langgestreckt und können Trivalente vortäuschen (Fig. 4). Bisweilen sind Einschnürungen in den Chromosomen, die gebildeten Chromosomenstücke liegen dann nicht selten auseinander, und sind nur durch einen feinen Faden vereint (Fig. 10). Unzweifelhafte Bivalente können

solchenfalls wie Trivalente aussehen. Die Einschnürungen sind oft an entsprechenden Stellen in zwei gepaarten Chromosomen. In solchen Fällen muss es sich um das Sichtbarwerden einer präformierten Struktur handeln, vermutlich der sogenannten sekundären Einschnürungen, die Kagawa in den somatischen Chromosomen von *Triticum* entdeckt hat, die zwar normalerweise nicht hervortreten, sondern erst nach Behandlung des Materials mit Chloralhydrat sichtbar sind (Kagawa 1928). Das Aussehen des in Fig. 11 abgebildeten Bivalents deutet vielleicht etwas darauf hin, dass zwei Chromosomen invers konjugieren können. Die Einschnürungen hatten in einigen Pollenmutterzellen zu einer wahren Fragmentation geführt.

Das Univalent war auch ein paar Mal mit einem drabantähnlichen Anhängsel versehen (Fig. 8). Der Drabant wurde nur in 418: 2 nicht aber in 421: 4 gesehen, dies ist wohl nur ein Zufall, und darf nicht so gedeutet werden, dass es ein Beweis dafür ist, dass in den beiden Linien verschiedene Chromosomen univalent sind. Das Univalent ist sonst sehr ähnlich in beiden, ist ungefähr in der Mitte gebogen, liegt oft schon von Anfang in der Äquatorialplatte, in der Peripherie derselben und quer zur Längsachsel der Kernspindel (Fig. 2 *a*). Meist wird es aber erst später wie die anderen Chromosomen in die Platte eingeordnet. Es wird in der Spindel längsgespalten, und die Spalthälften werden nach den beiden Polen transportiert, wenn die anderen Chromosomen ihre Bewegung beinahe abgeschlossen haben (Fig. 12). Zu jedem Pole gelangen also 20 $^1/_2$ Chromosomen (Fig. 13). Das beschriebene Verhalten des Univalents stimmt mit dem überein, was früher bei *Triticum* wie auch bei anderen Gramineen bekannt ist. So liegen bei tri- und pentaploiden *Avena*-Bastarden die Univalente zuerst auf der Kernspindel zerstreut, wenn die Bivalente schon eine Äquatorialplatte bilden, ordnen sich erst später in diese ein, und werden dort längsgespalten (Nishiyama 1929). In 421: 4 kam ziemlich oft die Verteilung 21 + 20 vor (Fig. 14), weil das Univalent in der ersten Reifeteilung ± ungespaltet nach dem einen Pole gehen kann. Nur selten wird das Univalent in der ersten Teilung eliminert (wie das Vagabundenchromosom von Winge). In der zweiten Reifeteilung geschieht aber sehr oft eine Elimination der Spalthälften, die nämlich eine neue Teilung nicht durchmachen können. Die Pollenzellen haben demzufolge sehr oft einen sehr kleinen Kern neben dem normalen (Fig. 15), der vom eliminierten Chromosom gebildet wird.

In 1 287 aus den Kulturen von Nilsson-Ehle wurde auch in B-Heterozygoten aus Panzerweizen $20_{II}+1_{I}$ Chromosomen in der ersten Reifeteilung gefunden. Das Univalent war hier länger (wohl der verschiedenen Fixierung zufolge) und oft konnte beobachtet werden, dass der eine Arm schmäler und etwas länger als der andere war (Fig. 6). Nicht selten war das Univalent ringförmig (Fig. 4), und hatte ein Aussehen wie bei sekundären Trisomen von

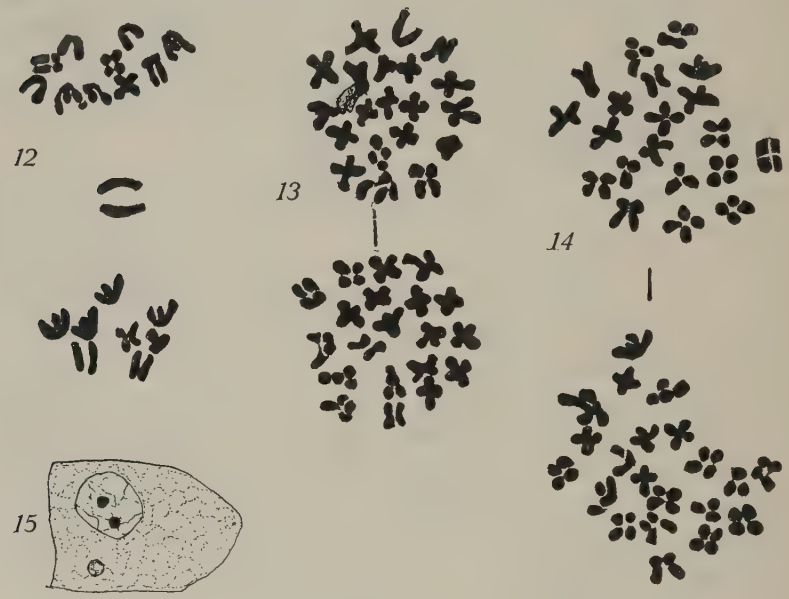

Fig. 12—15. — *12:* Teilung des Univalents. — *13:* Die beiden Polplatten derselben Pollenmutterzelle (das Univalent noch in der Mitte der Zelle). — *14:* Ditto. — *15:* Pollentetradzelle.

Datura. Es konnte auch fragmentiert sein (Fig. 5). Das Univalent wird auch hier meist längsgeteilt, aber nicht selten in das Zytoplasma ausgestossen und eliminiert.

Betreffs des Verhaltens des Univalents bei B-Heterozygoten habe ich also ähnliche Beobachtungen wie Huskins gemacht: Spaltung in der ersten Reifeteilung, Nichtspalten und häufige Elimination in der zweiten, die, wie Huskins ausführt, zur Bildung von mehr Gameten mit 20 als mit 21 Chromosomen führt, was den grossen Überschuss an Heterozygoten gegenüber Normalpflanzen in der Nachkommenschaft erklären kann. Die Normalpflanzen haben 21_{II} wie ich in 418: 1 von Åkerman und in 1 286: 1 von Nilsson-Ehle

fand. Doch waren Störungen während der Teilung der Chromosomen und abweichende Konjugation nicht selten zu beobachten (so Univalente und ein paar Male Quadrivalente in 1 286: 1).

In der Pflanze 418: 25: 7 aus den Kulturen Åkermans war immer in den Pollenmutterzellen ein Chromosomfragment vorhanden. 418: 25 ist eine Subcompactumlinie, die aus der B-Reihe 418 hervorgegangen ist; die einzige untersuchte Pflanze war ein Subcompactum, aber eine solche Fragmentierung ist nicht für Subcompactum kennzeichnend, wovon ich mich betreffs Materials aus den Kulturen Nilsson-Ehles überzeugen konnte, auch erwähnt Winge nicht das Vorkommen von Fragmenten in dem von ihm untersuchten Compactumheterozygot.

In der Reduktionsteilung von 418: 25: 7 waren $20_{II}+1_{I}+1$ Fr. vorhanden, dabei verhielt sich das Fragment ganz wie ein univalentes Chromosom, die Reduktionsteilung muss als regelmässig bezeichnet werden. Das Fragment ist ziemlich gross und ist offenbar dadurch entstanden, dass das Univalent zerfallen ist. Das vorhandene Univalent scheint hier kürzer, wie ein Vergleich der Figuren 12 und 18 zeigt. Besonders beweisend für die Zusammengehörigkeit des Fragments und des Univalents ist das Verhältnis, dass bisweilen das Fragment nicht frei sondern vermittels eines feinen Fadens mit dem Univalent vereint ist (Fig. 20); es wurde zweimal seitlich inseriert beobachtet (Fig. 20). Wie erwähnt hatte das Univalent in 418: 2 bisweilen ein ähnliches Anhängsel (vgl. Fig. 8), das aber entschieden kleiner als das Fragment in 418: 25: 7 ist. Dies kann ein zytologisches Indizium dafür sein, dass hier ein anderes Chromosom univalent ist. In Subcompactum mit 41 Chromosomen soll nach den Darlegungen von Winge ein B- statt ein C-Chromosom nur einmal vorhanden sein, die Pflanzen sollen nämlich zwei C- und ein B-Chromosom haben.

Nur sehr selten sind Fragment und Univalent miteinander in der ersten Metaphase gepaart (Fig. 21); sie haben in der Regel anfangs eine sehr verschiedene Lage auf der Kernspindel (Fig. 16). Aber merkwürdigerweise pflegt sich auch das Fragment später in der Kernplatte einzureihen, und dort gleichzeitig mit dem Univalent eine Teilung durchzuführen, wonach die Hälften nach verschiedenen Polen gelangen (Fig. 18). Mehr selten wird das Fragment in dieser Teilung eliminiert. Die Bivalente können sich abweichend verhalten. Fig. 17 zeigt wie sich zwei zur Bildung eines grossen

Ringes vereint haben. In der zweiten Reifeteilung geht das Fragment meistens verloren. Es bleibt dann ungeteilt, und seine Polwanderung ist so verspätet, dass es nicht in den Tetradenkernen gelangt (Fig. 19). Nur selten dürften also die Kerne der Pollenzellen dieser Pflanze Fragmente enthalten.

Die Fragmentation und ihre Bedeutung ist neulich von Darlington diskutiert, der hervorhebt, dass gebildete Fragmente es

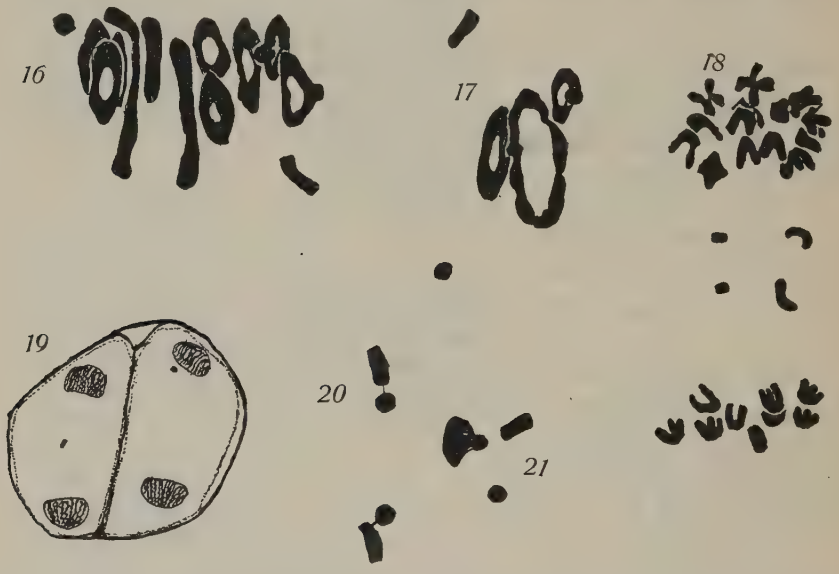

Fig. 16—21. — Subcompactum. *16, 17:* Metaphase der ersten Reifeteilung — *21:* Ditto. — *18:* Teilung von Fragment und Univalent. — *19:* Telophase der zweiten Reifeteilung. × 1050. — *20:* Fragment mit dem Univalent vereint.

schwer haben, die Reduktionsteilung durchzuführen, so dass in Pflanzengenera, wo sexuelle Reproduktion und Kreuzung Regel ist, Bildung neuer Chromosomen durch Fragmentation nicht vorkommt (*Triticum* wird u. a. als Beispiel angeführt), die phylogenetische Bedeutung der Fragmentation also sehr beschränkt sein dürfte (Darlington 1929). Indessen gibt es aber offenbar Fälle, wo man nicht umhin kann, eine solche Chromosomenbildung anzunehmen (z. B. in *Scirpus palustris,* Håkansson 1929), und es ist wohl so, dass unsere Erfahrungen über das Vorkommen und Verhalten der Fragmente in der Nachkommenschaft von fragmentführenden Pflanzen noch ziemlich mager ist. Das Fragment in 418: 25: 7 ist in zweifacher Hinsicht von Interesse. Teils kann man konstatieren,

von welchem Chromosom es abgesondert wurde, teils frappiert sein regelmässiges Verhalten während der Reduktion. In den Fällen, wo das Verhalten von Fragmenten während der Reduktionsteilung studiert worden ist, bleiben sie meist ungeteilt in der ersten Reifeteilung. Doch hat DARLINGTON bei *Tradescantia virginiana* var. *humilis* Teilung der Fragmente wie die hier beschriebene gefunden (l. c. S. 234). Dass das Fragment von 418: 25: 7 so oft in der zweiten Reifeteilung eliminert wurde, beruht offenbar darauf, dass es nicht eine neue Teilung durchmachen kann, was wie betreffs der Univalente doch in noch höherem Grade eine Verspätung der Polwanderung mit sich bringt. Man kann erwarten also, dass wenn eine Pflanze mit zwei Fragmenten in der Nachkommenschaft entsteht (was allerdings sehr selten geschehen dürfte), in der die zweite Teilung normal d. h. ohne Elimination vor sich gehen soll. Doch ist dabei zu bemerken, dass nach den Ausführungen DARLINGTONS infolge unvollständiger Chiasmabildung zwischen den sehr kurzen Fragmenten ihre Paarung oft ausbleiben dürfte, was in unregelmässigem Verhalten während der Reduktion nicht selten resultieren sollte.

Die hier untersuchte Subcompactumpflanze hatte also eigentlich 41 Chromosomen, und unterscheidet sich von der von WINGE studierten, in der 42 Chromosomen vorhanden waren.

In 424: 3 wurde ein ziemlich eigentümliches Verhalten der Chromosomen in der ersten Reifeteilung gefunden. Es kommt nämlich ausser 20 gewöhnlichen Bivalenten anscheinend ein heteromorphes Bivalent vor, das aber ein Trivalent ist, in dem zwei Chromosomen immer fest unter Bildung eines zusammengesetztes Chromosoms vereint sind. Zytologisch ist also 424 eine C-Reihe, es scheint aber, als ob das neue Chromosom nur etwa $^2/_3$ der Länge des gewöhnlichen B-Chromosoms besitzt.

Das Trivalent kann am besten im Anfang der Anaphase beobachtet werden (Fig. 22, 23). Das zusammengesetzte Chromosom ist offenbar dadurch entstanden, dass dem einen Ende eines gewöhnlichen Chromosoms ein gerades Chromosomenstück zugefügt ist. In der Metakinese variiert das Aussehen des Trivalents dagegen bedeutend (Fig. 25). Es sieht oft wie »Ring mit Stab» (»ring and rod») aus, der Stab von dem kurzen Chromosom gebildet. Querarme an gewöhnlichen Bivalenten sind dicker und in der Regel kürzer als der »Stab», so dass man meist mit Sicherheit das Trivalent

unterscheiden kann. Oft hat es schon jetzt das oben beschriebene Aussehen von heteromorphem Bivalent, weil sich da, wo der »Stab» eingefügt ist, der Ring geöffnet hat. Schliesslich kann, doch mehr

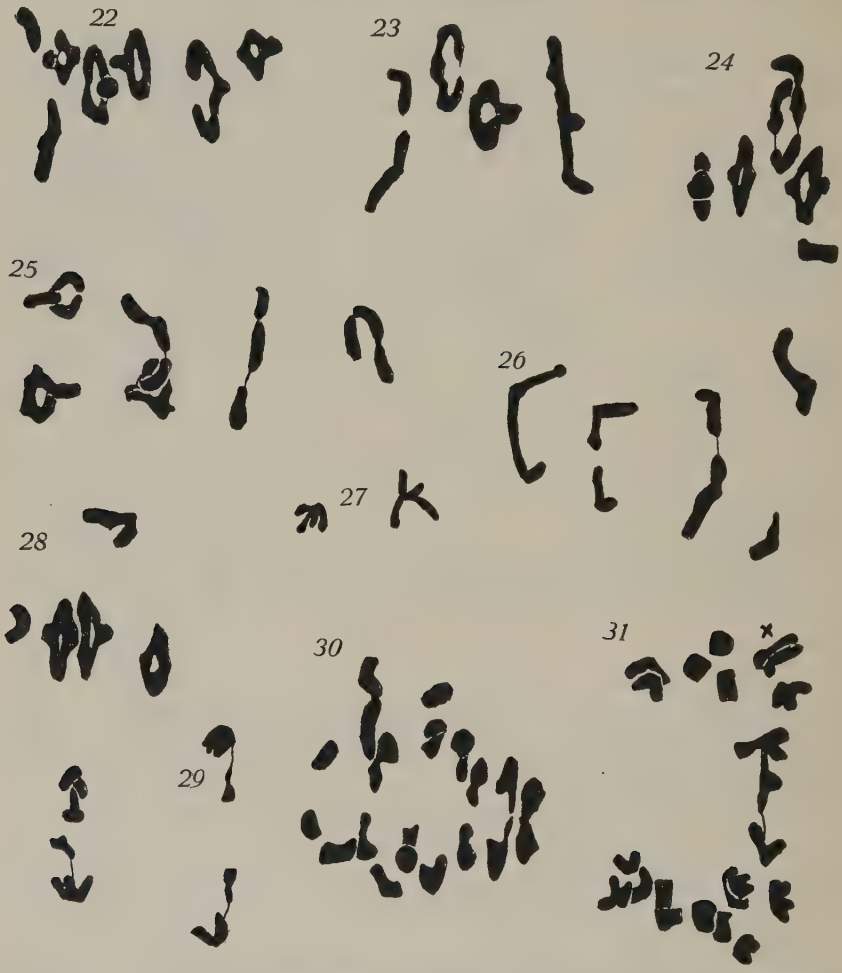

Fig. 22—31. C-Heterozygot. *22, 23:* Beginnende Anaphase der ersten Reifeteilung. — *25:* Trivalente in der Metakinese. — *26:* Trivalente in der Meta- bis Anaphase. — *27:* Das zusammengesetzte Chromosom in der Telophase (rechts). — *24* und *28:* Abweichende Konjugation. — *29:* Bivalente in der Anaphase. — *30, 31:* Anaphase der ersten Reifeteilung.

selten, eine Einschnürung die sonst so fest verbundenen Chromosomen trennen, dass die trimorphe Natur des Trivalents deutlich ist (Fig. 25). In der mittleren und späteren Metaphase kommt schon

nicht mehr »Ring mit Stab» vor, sondern das Trivalent sieht wie ein heteromorphes Chromosomenpaar aus (Fig. 26). Die anaphasische Bewegung fängt hier in der Regel früher als in den Bivalenten an (Fig. 22), von denen einige sehr langgestreckt sein können (Fig. 23). Von Gewicht ist, dass sich das neue Chromosom nie lostrennt, während der Polwanderung kann man in günstigen Fällen das grosse zusammengesetzte Chromosom unterscheiden (Fig. 26, 30, 31). In beiden Ana- oder Telophaseplatten sieht man infolgedessen immer 21 Chromosomen (vgl. Fig. 32), und bisweilen kann auch im Querschnitt das grosse Chromosom deutlich sein (Fig. 27 und 32).

Es wurde nicht selten beobachtet, dass das zusammengesetzte Chromosom und sein Partner unkonjugiert waren (Fig. 28). In Fig. 24 ist eine andere Abweichung abgebildet. Das Trivalent ist mit einem anderen Chromosom vereint, dessen Partner univalent ist, oder das zusammengesetzte Chromosom hat mit einem Bivalent konjugiert.

Die zweite Reifeteilung ist meist regelmässig, und ziemlich selten erfolgt eine Elimination von Chromosomen. Leider konnte die Chromosomenzahl nicht bestimmt werden, die Bouin-Fixierung ist vielleicht nicht geeignet für diese Stadien, die Chromosomen sind sehr langgestreckt, sehen wie somatische Chromosomen aus, aber stossen gern aneinander; es konnte also nicht festgestellt werden, ob das zusammengesetzte Chromosom jetzt zerfallen ist.

In 419: 4 wurde eine ganz ähnliche Reduktionsteilung gefunden, es wurde aber nur eine Pflanze untersucht (Fig. 33, 34). Hier waren bisweilen zwei Bivalente miteinander vereint (Fig. 35, 36). Das zusammengesetzte Chromosom verhielt sich während der Teilung wie in 424: 3 (Fig. 32, 37), auch hier kam nicht selten Nichtkonjugieren im Trivalent vor, so dass das zusammengesetzte Chromosom frei war. Die zweite Reifeteilung war regelmässig.

419: 4 ist schon von Huskins unter dem Nummer 1924: 444 untersucht. Er fand $1_{III}+20_{II}$, das Trivalent trat aber als »Ring mit Stab» auf, und der stabförmige Teil wurde in der ersten Reifeteilung sehr oft längsgespaltet, so dass vom Trivalent also oft 1 ½ zu jedem Pole langten, in den Polplatten waren also oft 21 Chromosomen. Eine solche Teilung des Trivalents habe ich aber nicht beobachtet. Bilder, die die Fig. 34 von Huskins ähnelten, wurden bisweilen beobachtet (Fig. 29, 31), aber es handelte sich um die Teilung von Bivalenten. Dieselbe Chromosomenanordnung haben, wie es

scheint, wir beide gefunden, aber das Verhalten des Trivalents kann offenbar verschieden sein, was auch zu einem verschiedenen Verhalten desselben während der zweiten Teilung führen muss, in der Huskins oft Elimination beobachtete.

Nach Mitteilung von Doktor Åkerman hatte er 424 das erste Mal im Jahre 1928 in Kultur, und es spaltete dann in 30 Normalpflanzen: 28 Heterozygoten: 4 Homozygoten. Es sollte also eine A- oder C-Reihe sein. 419 hat einen sehr ähnlichen Spaltungstypus,

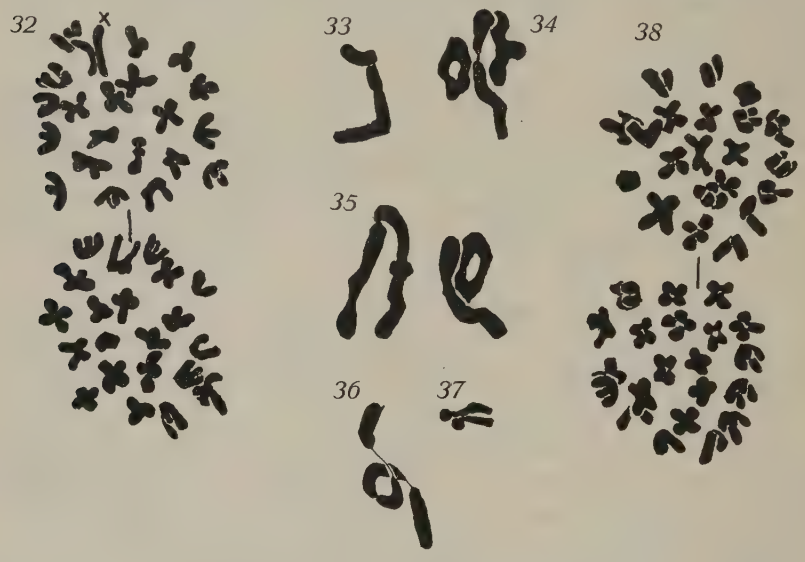

Fig. 32—37. C-Heterozygot. *32:* Die beiden Polplatten derselben Pollenmutterzelle. — *33:* Trivalent. — *34:* Trivalent und zwei Bivalente. — *35, 36:* Vereinigung von Bivalenten. — *37:* Das zusammengesetzte Chromosom in der Telophase. — *38:* Die beiden Polplatten derselben Pollenmutterzelle eines C-Homozygots.

also ungefähr eben so viele Heterozygoten wie Normalpflanzen und wenige Homozygoten (siehe in Huskins S. 114). Zytologisch sind auch 419 und 424 also nach meiner bisherigen Erfahrung übereinstimmend, sie sind C-Reihen, die vermutlich doch nicht ein ganzes B-Chromosom im Überschuss haben.

Die somatischen Chromosomen wurden nicht untersucht. In den Homozygoten zu diesen beiden Reihen scheinen nach meinen bisherigen sehr fragmentarischen Untersuchungen verschiedene Chromosomenzahlen vorzukommen. In einer Keimwurzel von 424-Homozygote wurden mit Sicherheit in mehreren Kernplatten 42

Chromosomen gezählt, in einer anderen schienen aber 44 Chromosomen vorhanden zu sein. In einer homozygotischen Pflanze zu 419 gelang es Huskins, 44 Chromosomen festzustellen. Ich hatte nur ein Präparat von einer solchen Pflanze, 419: 14, es waren aber deutlich 21 Chromosomen in den Polplatten der ersten Reifeteilung vorhanden (Fig 38). Weitere Untersuchungen müssen hier einsetzen.

Das zytologische Problem der Speltoidheterozygoten erfordert die Beantwortung von zwei Fragen. Haben sie einen anderen Chromosomenbestand als *vulgare,* und wenn ja, ist ein bestimmter Spaltungstypus mit einem bestimmten Chromosomenbestand verknüpft? Meine noch wenig umfassende Studien an das Material von Åkerman deuten darauf hin, dass auch die letztere Frage bejaht werden kann. Die Zytologie von 418 und 421 ist sehr ähnlich, beide gehören zu typischen B-Reihen, 424 und 419 haben auch übereinstimmende Zytologie und Spaltung.

Lund, Botanisches Institut, im Januar 1930.

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Svensk Botanisk Tidskrift. 1930. Bd. 24, H. 1.

FRÅN ÖSTRA LAPPLAND. OM KÄRLVÄXTFLORAN I MALÅ SOCKEN I LIDERNAS REGION.

AV

ERIK G. VRETLIND.

I sin uppsats år 1922 om Arasjöfjällen, en isolerad lågfjällsgrupp mitt i skogsområdet i södra Lappland, huvudsakligen i Lycksele och Vilhelmina socknar, talar Sernander om »vår sorgliga obekantskap med naturförhållandena i östra Lappland, lidernas region». »I norra Europa torde ej med undantag för Nordryssland öster om Fennoscandias gräns kunna uppletas ett stycke land av dess ofantliga omfattning, så illa känt i naturhistoriskt hänseende.»

Efter denna påstötning kommo i Svensk Botanisk Tidskrift årg. 1924 växtförteckningar, dels av D. och C. B. Gaunitz från Sorsele, vilken socken utom ett betydligt fjällområde innefattar även ett gott stycke av regio silvatica, d. v. s. den ovan omtalade terra incognita, och dels av O. Vesterlund från Jokkmokks och Kvikkjokks skogsregion, år 1926 Th. Arwidssons Studier över sjöarnas vegetation i Lilla Luleälvs vattenområde mellan Jokkmokk och Kvikkjokk samt 1927 G. Samuelssons Växtlokaler från Åsele och Dorotea socknar.

Här följer nu en motsvarighet till Sorseleredogörelsen från den närmast sydost om Sorsele liggande delen av Lappland, den nästnäst minsta av lappmarkssocknarna, Malå, i Lycksele lappmark, 17,3 kvmil stor, mellan 65° och 65° 30′ n. br., stötande intill Norsjö s:n i landskapet Västerbotten, vilket här skär in ett hak i Lapplandskanten, och mellan Lycksele socken i söder och Skellefte älv i norr. Höjden över havet är 250—400 m, i medeltal ungefär 330 m.

Berggrunden i denna socken har under 1920-talet blivit noga undersökt på grund av där anträffade malmer. De förhärskande bergarterna äro graniter, porfyrer, porfyriter och tuffbildningar; på spridda ställen, mest i nedre delen av socknen, uppträda Skellefteformationens kvarts- och lerskiffrar. Av kalksten skall endast finnas ett obetydligt stråk SO om sjön Släppträsk, där förr av enskild person försök gjorts med kalkbränning av lösa block. Förekomsten synes mest ligga under myrmark, och någon inverkan på vegetationen har förf. icke märkt. De lösa jordlagren äro morän, torv- och dyjord; utmed Malån och Skellefte älv rullstensåsar. Uppemot älvens stora sel (Bastuselet) i socknens nordspets, utmed Maláträsk och kring sjön Skäppträsk, kanske än vidare, finns ur moränen utslammad finkornig, tätt packad, ljus mjäla, vid den sistnämnda sjön ställvis blåaktig, använd som lera till tegelbränning. Efter vad kvartärgeologiska kartor ge vid handen, ligger dock socknen helt ovan marina gränsen. På vegetationen har mjälan ingen synbar inverkan.

Åtskilliga sjöar och talrika skogstjärnar förekomma; störst är Skäppträsk, ungefär 10 kvkm, Släppträsk 7,8 kvkm; Skellefte älv utgör som nämnt socknens (och länets) nordgräns, nederbörden avflyter f. ö. genom dels den för det mesta dyiga Skäppträskån, som upprinner i socknens nordvästra parti, dels den steniga Malån, som kommer från Sorseles skogsregion och genomlöper hela Malå socken för att i Norsjö i Västerbotten förena sig med de båda förutnämnda. Sjön Maláträsk är en milslång utvidgning av denna å. I sydhörnet av socknen de kortare åarna Rökå, Vormbäcken och Storbäcken (till Mensträsk).

Under somrarna 1923—1929 (utom 1925) har förf. tillbringat tillhopa 8 $^{2}/_{3}$ månader därstädes, och första bekantskapen gjordes i mitten av juni 1923, en ovanligt grå och sen försommar, då björken slog ut till midsommar och granen i början av juli.

Sernander säger om Arasjöområdet: »I hela vårt land torde man få leta efter ett område av motsvarande storlek med en så artfattig flora», och Samuelsson om Siksjö bys omgivning i Åsele med motsvarande läge: »Området torde höra till de artfattigaste i Sverige.» Som exempel på de rikaste lokalerna anför Sernander lindorna och småbäckarnas stränder. Alldeles detsamma gäller om Malå med den utökning, att till småbäckarnas stränder få här läggas åarnas och älvens. Första intrycket nämnda sena sommar var för sörlänningen en rent av förkrossande torftighet. Ingen grönska

på marken ännu strax före midsommar, utom på landsvägsrenarna, de små åkrarna och gödslade vallarna vid de sparsamt förekommande gårdarna och det lövade blåbärsriset i en del av skogen. (Senare på sommaren något enda starrkärr och någon skogsslåtteräng samt smala strandremsor styckevis vid vattendragen.) Man måste undra på vad de på bete utsläppta kreaturen skulle livnära sig av. De följande besöken ha dock givit en åtskilligt gladare syn på saken, beroende dels på vanans makt, dels på både till tid och rum mer utsträckt bekantskap med området, då gynnsammare väderlek utövat sitt inflytande, framlockat mer ur den karga jorden. Förf. har bott i Kyrkbyn, mitt i socknen, och känner någorlunda fullständigt blott området däromkring; har därifrån gjort upprepade utfärder i de olika riktningarna.

Botaniskt finnes veterligen från Malå publicerat endast några sporadiska upplysningar av läroverksadjunkten fil. dr. C. A. Melander i Skellefteå i samband med meddelanden från den trakten och från resor därifrån genom Norsjö, Malå och Lycksele till Åsele och Tärna.

Att förf. vågar, efter att icke alls eller helt ytligt ha överfarit stora delar av området, komma med en redogörelse för floran, beror dels på att färderna givit vid handen, att växtsamhällena äro i stort sett överallt de samma och med väsentligen samma sammansättning, dels på att en del uppgifter beredvilligt lämnats av andra. Här är platsen att tacka i första rummet revirföreståndaren, förf:s broder, jägmästaren J. E. Wretlind (J. E. W.), vilkens ämbetsområde fr. o. m. 1927, på ett minimalt undantag när, sammanfaller med socknen; omfattade förut i 6 år dess södra hälft. Icke blott speciella växter och växtlokaler har han meddelat utan från början satt förf. in i förhållandena i stort, förevisande åsträder och grankälar, och sedan under alla åren varit råd- och upplysningsgivare angående olika områdens natur och lämpliga orter att besöka och praktiskt befordrat förf:s färder. Såsom själv intresserad i praktisk botanik — skogsskötsel — har han med vakenhet och skarpsinne bedrivit egna undersökningar rörande dessa växtsamhällen och deras sammanhang med den övriga naturen och kulturen nu och i förgången tid och villigt meddelat av sina rön, så att, om den allmänna avdelningen av redogörelsen innehåller något av värde, är förtjänsten hans.

Vidare tackar jag läraren vid kommunala mellanskolan i Västanfors fil. mag. Johannes Björzén, uppvuxen i kyrkbyn såsom son till sock-

nens av växter intresserade förste kyrkoherde. Med honom genomgick förf. systematiskt Norrlands kärlväxtflora och fick anteckna hans erfarenheter därutinnan i Malå, kom därigenom fortare in i situationen s. a. s.

Icke få uppgifter ha med glädje och tacksamhet mottagits från den intresserade växtsamlaren, jägmästaren Georg Nylander, vilkens verksamhet sedan 5 ½ år sträcker sig över det nuvarande reviret. Honom har förf. bl. a. uteslutande att tacka för kännedomen om två av områdets växter.

Till läraren vid kyrkskolan H. E. Forke stannar förf. likaså i tacksam förbindelse.

I fråga om gräs och halvgräs äro dessa herrar icke sakkunniga, utan där är föga mer att omtala, än vad förf. själv kunnat iakttaga. Visserligen kan redogörelsen icke göra anspråk på absolut fullständighet, ännu sista tiden gjordes flera nyfynd. Klarare än efter första sommaren inser förf. bristerna i sin kännedom av ämnet. Möjligt är alltså, att ännu en och annan art (även utom släktena *Hieracium* och *Taraxacum*!) finns att tillägga, och framför allt kunna naturligtvis icke alla växtlokaler anges. Skulle förf. emellertid vänta, tills insikten bleve fullständig, är fara värt, att redogörelsen aldrig utkomme. I slutet lämnas en jämförande framställning med andra närliggande områden, av vilken framgår, vad som närmast kan tänkas vara förefintligt men hittills icke påträffats.

Områdets hieracier lära till en del vara obeskrivna arter; av dem som namnges, ha några få godhetsfullt bestämts av framlidne fil. dr. K. Johansson men flertalet av fil. dr. H. Dahlstedt; insamlade *Taraxacum*-former av dr. Dahlstedt; några *Poa*-arter av framlidne prof. C. Lindman; *Betula*-prov av icke-masurbjörk har apotekaren J. G. Gunnarsson varit så vänlig att namnge. I övrigt ha prof. G. Samuelsson och fil. dr. Erik Almquist, där förf. varit oviss, tillhandagått med välvillig granskning, varjämte prof. Samuelsson givit nyttiga anvisningar för kompletterande undersökningar. Till ännu levande medarbetare och granskare framföres ett vördsamt och hjärtligt tack!

* * *

Utom de hydrofila växtsamhällena och den som helt små och långt åtskilda öar kringströdda kulturjorden (enl. 1928 års taxeringslängd 0,62 % av arealen) behärskas hela trakten av barrskogen. Det är de vanliga norrländska typerna av barrskog;

längs Skellefte älv och Malån spelar den torra, magra tallheden en stor roll.

Björk förekommer insprängd i barrskogen, glasbjörk, som är den vanligaste, naturligtvis mest på fuktig grund. Gråal, rönn och hägg mest vid vattendragen men blott små individ, föga mer än 2—4 m höga; smårönn kan träffas i skogskanten vid myrar; rönnplantor litet varstädes i skogarna, men beskuggningen hindrar deras vidare uppväxt (J. E. W.); utom vid åarna skall på Nådagubbsliden i ung granskog finnas utvuxen rönn (J. E. W.). Sälgträd sparsamma, deras bark användes vid hemgarvning (J. E. W.). Asp-uppslag allmänt men utvuxna träd sällsynta; dels lär aspen fordom liksom sälgen ha förbrukats till pottaskebränning, som då var ett det fattiga landets näringsfång, dels har man fått för sig (liksom tyvärr ock annorstädes!), att den är ett ogräs, som bör utrotas (J. E. W.). Den har ju varken timmer- eller vedvärde, och först nu har tändsticksindustrien sträckt sina inköp hit upp. Att — undantagandes björk — verkliga löv-träd äro så sällsynta, måste bero på människans härjningar. Även björken förödes oerhört. Anskaffandet av tillräckligt vinterfoder åt husdjuren är nämligen jordbrukarens stora bekymmer, därför får lövskogen stryka med: björken avtoppas, nedbrytes eller fälles och avkvistas; resterna erbjuda en dyster syn! Främst tages *Betula verrucosa*, som lär vara den enda av nötboskapen fullt gillade. Av aspen [även sälg och rönn (J. E. W.)] tillvaratages vid foderbrist stundom ock de yngre stamdelarnas bark för samma ändamål. I västra sockenkanten vid Granberget, i centrum på sydsluttningen av Nordberget (NO om Tjamstan) och på översta delen av Fnöskberget, det högsta inom området, har förf. sett mer björk, rent av björkskog med inblandad gran och, på de båda första ställena, asp. Vid Aspliden i södra sockenkanten har funnits åtskillig asp, som nu till stor del avverkats och sålts till tändsticksindustrien (J. E. W.). På sina håll t. ex. i socknens nordspets på Öberget, i dess sydhörn kring Rökåberg och i trakten av Hornberg är barrskogen, såsom ock generalstabskartan anger, mer björkblandad utan att dock i förf:s ögon förlora sin karaktär av väsentligen barrskog. Vid skogsavverkningen nedhuggas även strändernas lövträdsbestånd.

Kring gårdarna finns gärna av hänsyn till faran vid skogseld (J. E. W.) en röjning, slätta, med björk- och aspbuskar; invid husen som prydnad en och annan större björk, rönn, asp eller sälg, och här, där de få utvecklas i fred, kan man få se grova aspar,

och även rönnen når verkliga träddimensioner. Hägg i verklig trädform ses dock knappast ens där men väl ca. 6—8 m höga buskar, rikt blommande. [Pungsjuka (*Taphrina pruni*) saknas icke!] Om gråalen någon sällsynt gång får stå i fred, växer ock den upp till träd. Enen är allmänt utbredd; bildar aldrig såsom längre söderut (redan i Jämtland) en sluten buske med topp; snötrycket pressar ned den; endast en krets av bågformigt uppstigande grenar kommer till stånd.

Jämte skogen är det de talrika och ofta stora myrarna, som karakterisera vegetationen. Liksom annorstädes finnas dels våta dykärr med en (stundom gles) vegetation av t. ex. *Carex limosa*, *C. livida*, *Eriophorum angustifolium*, *Juncus stygius* och ibland lysande röda av *Drosera longifolia*, dels något torrare kärr med antingen *Scirpus caespitosus* eller *Scirpus alpinus*, dels grågröna eller gröna starrkärr (slåttermyrar) med diverse *Carices*, *Eriophorum angustifolium* och *Scirpus alpinus*, dels mossar med *Sphagna*, *Oxycoccus*, *Andromeda polifolia*, *Rubus chamaemorus*, *Drosera rotundifolia*, *Pinguicula villosa* eller, om de äro mycket våta, *Sphagna*, *Carex limosa* och *Scheuchzeria*, märkbar genom sina långa, styvt uppräta, trinda, höggröna blad; dels slutligen rismossar med rik buskvegetation av framför allt dvärgbjörk men ock en, skvattram (*Ledum*) och videarterna och med *Carex globularis* som karakteristisk undervegetation; någon gång dvärgbjörksrismossar med björnmossa (*Polytrichum commune*) och hjortron under. Övergångar finnas naturligtvis. Jenmyrgräset [*Molinia coerulea;* jen = *Juniperus* (J. E. W.)] bildar ofta upphöjda gröna lister och låga tuvor i myrarna (vare sig att de nu äro flytfenomen eller biologiskt bildade), på vilka mindre hydrofila växter såsom *Juniperus*, *Potentilla erecta* och *Parnassia* finna en tillflykt. — Utdikning av våtmarkerna pågår numera allmänt med statens understöd. [Den av denna landsdels myrar intresserade hänvisas till Carl Malmströms avhandling, Degerö Stormyr, i Meddelanden från Statens Skogsförsöksanstalt, h. 20, 1923.]

Sjöarnas kärlväxtvegetation är icke yppig, oftast synnerligen fattig. Vattenklöver (*Menyanthes*) är den allmännaste blomväxten i skogstjärnarna; i grunda vattengropar i skogen gulkavle (*Alopecurus aequalis*) och fjälligelknopp (*Sparganium hyperboreum*), ibland jämte ledkrans (*Hippuris*); eljes förekomma i sjöarna mest flaskstarr (*Carex rostrata*) såsom kantvegetation, vattenfräken (*Equisetum limosum*), bladvass (*Phragmites*) i glesa, lågväxta bestånd, igelknopp

(*Sparganium affine*), näckrosorna (*Nuphar luteum*, *Nymphaea candida*), grodnate (*Ranunculus peltatus* v. *suecicus*) och någon *Potamogeton*. Malåträsk, som vid Kyrkbyn är eller varit igenväxande, och de andra rinnande vattnen äro rikare, med, utom de ovannämnda växterna, braxengräs (*Isoëtes lacustris*), nålsäv (*Scirpus acicularis*), sjösäv (*Sc. lacustris*), flera *Potamogeton*-arter, lonke (*Callitriche verna*), sylört (*Subularia*), hårslinga (*Myriophyllum alterniflorum*), stor blåsört (*Utricularia vulgaris*), mellanblåsört (*U. intermedia*), notblomma (*Lobelia*).

Sydberg.

Under den, botaniskt sett, dystra första tiden i Malå drogs förf:s uppmärksamhet strax till det sig öster om Kyrkbyn isolerat höjande, skogbevuxna berget

Tjamstan,

vilket på grund av sidornas (mest den södras) tvärhet med blottade hällar icke som de helt moräntäckta bergen i trakten benämnes lid utan berg. (Namnets härkomst oviss.) Höjden över havet 467 m, Kyrkbyns bredvid 315,4 m. Bergarten är blå porfyrit. Övre ytan platåartad med mossrik barrblandskog med blåbärsris. Sydsidan har överst lodräta, sedan brant sluttande väggar med många smala, sluttande avsatser och stenras och därnedom dels naken blockanhopning (ur), dels vegetationstäckt, skogklädd, starkt stupande sluttning. Till denna sida ansluter sig Malåns rullstensås, lämnande styckevis en kärrmark innanför sig mot berget. Barrskog kläder m. l. m. alltsammans, nere på åsgruset tallhed, i den skarpa branten gles tallskog med något asp, björk, rönn, sälg och en, men många öppna, solstekta ytor. I väster är sydsidan torr, österut framträder fuktighet ur grunden, och skogen övergår till mossrik granskog med blåbärsris; i sänkor kan vatten direkt iakttagas. På sin östsida blir berget åter torrare. Västsidan är mindre brant med mossrik barrskog, i gamla erosionsfåror där storormbunksförande grankälsvegetation.

I sydbranten finns typisk sydbergsflora. Det intresse, som denna väckte hos förf., jämte Sernanders i inledningen anförda ord gav upphov till den undersökning, vars resultat här framlägges.

B. betecknar uppgift av fil. mag. J. Björzén, J. E. W. d:o av jägmästare Wretlind, N. av jägmästare Nylander. ! efteråt betyder, att förf. själv sett den angivna växten på ifrågavarande lokal eller därifrån hämtade exemplar.

Den solöppna torra branten med blockmarken därnedom.

Jämte i trakten m. l. m. allmänna växter såsom *Agrostis tenuis, Antennaria dioica* (här i branten nästan uteslutande den även ovanpå gråbladiga formen), *Arctostaphylos uva ursi, Calamagrostis lapponica, Calluna vulgaris, Cerastium caespitosum, Deschampsia flexuosa, Epilobium angustifolium, Erigeron acris, Hieracium subcaesium-* och *silvaticum*-former (*stenolepis* Dahlst., *coadunatum* Dahlst.), *Rhinanthus minor* (på ett enda ställe med sipprande fukt), *Rubus saxatilis, Solidago virgaurea* och *Vaccinium vitis idaea*, förekomma en del mer sällsynta, nämligen

Botrychium lunaria (spars.)
Convallaria majalis (spars.)
Fragaria vesca (rikl.)
Melica nutans
Poa nemoralis (icke typisk)
Rubus idaeus
Viola montana

ävensom några, som annorstädes alldeles icke finnas i den ursprungliga vegetationen eller blott på någon enda lokal och här böra betecknas som sydbergsväxter:

Anthyllis vulneraria (B.!)
Campanula rotundifolia
Cystopteris fragilis (spars.)
Epilobium collinum (icke typ.)
Hieracium arctogenum Norrl.
» *diasemum* Omang
Poa glauca o. subsp. *glaucantha*
Polypodium vulgare
Potentilla argentea
Rumex acetosella
Veronica officinalis (rikl.)
Viscaria alpina (rikl.)
Woodsia ilvensis (rikl.)

Campanula rotundifolia och *Rumex acetosella* äro visserligen allmänna på av människan använd mark, men ingå icke i några andra ursprungliga associationer än sydberg.

Av *Anthyllis* blott få exemplar högst uppe vid krönet, därnäst sparsammast *Hieracium arctogenum* och *Potentilla argentea.* Närmaste fyndort för *Anthyllis* torde vara vid Svansele vid Skellefte älv i Norsjö s:n, > 5 mil härifrån (Melander, Sörlin). Vid Vindelälven finns den enligt Melander. När den uppträder i fjällen i västra Lappland såsom i Tärna (Andersson) och Lule och Torne lappmarker (Frödin; Smith 1924), måste den där betraktas som västlig invandrare.

Potentilla argentea finns i Lapplands sydberg även vid Lulevattnet (Frödin), 435 och 504 m ö. h. och i fjällområdets mångenstädes, i Jokkmokk som ruderat (Vesterlund.)

(För den händelse, att någon framdeles skulle träffa *Sedum annuum* i branten, meddelas härmed, att några exemplar ditsattes 1929 av förf.)

I blockhavet (uren)

utom bergmossor och lavar

Erigeron acris
Epilobium angustifolium
Poa glauca och *glaucantha*
Pyrola chlorantha
Rubus idaeus
Viola Riviniana,

den sistnämnda endast i ett och annat exemplar åt öster, där torrheten är mindre.

Nedom uren står direkt med skarp gräns tät ung tallskog (pinetum hylocomiosum et myrtillosum). I en grankälsartad sänka här i kanten mot uren, med *Ptilium crista castrensis* som bottenskikt, finns jämte

Dryopteris Linnaeana
Geranium silvaticum
Lycopodium selago
Paris quadrifolia
Pyrola uniflora

dels rätt rikligt *Galium triflorum,* dels, fortfarande i skuggan men på högre, torrare läge, några få exemplar *Erigeron elongatus*, $^{12}/_{8}$ 1928, en ovanligt kall sommar, ännu icke i blom, men 6 dm hög. — På ännu ett ställe i samma tallungskog nedom blockmarken har *Galium triflorum* anträffats av hr Forke. *Pyrola chlorantha* växer också i skogen.

Habak

kallas ett liknande tvärbrant sydberg 1 $^{1}/_{2}$ mil västligare, utgörande sydligaste utposten av Fnöskberget. (Namnet Habak förekommer flerstädes i Lappland; skall vara lapskt och enligt magister Forkes förfrågningar beteckna örn eller annan rovfågel. Antagligen syftar det på att dylika, t. ex. pilgrimsfalkar, häcka i sådana branter. Men misstänkt synes förf., att lapparna lånat ordet av våra germanska förfäder, då man vet, att hök på fornsaxiska hette habuc. Jfr det norska hauk.)

Liksom denna sydvägg i utsträckning är mindre än Tjamstans, är ock floran fattigare. Bergroten ovan stenuren är bevuxen med björk, asp, sälg och rönn; avsatserna med mjölon, lingon, hallon och en. Bland örterna märkas *Epilobium angustifolium* och *collinum*, *Erigeron acris* (högväxt, nästan glatt skuggform) och *Melica nutans.* I bergspringorna *Woodsia ilvensis* (rikl.), *Polypodium vulgare* (spars.),

Cystopteris fragilis (spars.) och på själva bergväggen, bakom en gran, luxurierande *Sticta pulmonaria.*

I skogen nedom den moss- och lavhöljda uren *Goodyera repens.* Som sydberg kunna möjligen ock betraktas de blåsvarta

skifferklipporna på norra Malåstranden

inemot och vid Storforsen, just innan ån lämnar Lappland och går in i Norsjö s:n. Där träffas sydbergsväxterna

Campanula rotundifolia (rikl.)
Hieracium minuriens Dt.
» *coronopus* Dt.
Hypochaeris maculata (spars.)
Woodsia ilvensis (rikl.)

I skogskanten ovanför *Carex digitata,* som finns även annorstädes på skiffern; dessutom den vanliga åstrandsfloran (se längre fram). — *Hypochaeris* fann Melander i Norsjö på två, som det låter, likartade lokaler: Vargforsen i Skellefte älv, mängdvis; Svanfors, litet längre ned, få exemplar; han kände den blott på en lokal till i länet, i Nordmaling. Hartmans Flora (1879) anger Ume lappm. som dess nordgräns (Lindmans säger blott Lappl.). Som den icke finns i Tärna eller Sorsele (Andersson & Birger, Gaunitz) och saknas i norra Norge (Ove Dahl: A. Blytt Norges Flora), måtte här i Malå vara den nordligaste växtplatsen i Skandinavien.

* * *

Icke alla geografiska sydberg äro botaniska sådana. De branta sydsidorna av t. ex. Granberget, Fårberget, Nordberget ha inga särskilda sydbergsväxter. Det beror enligt revirföreståndarens tydligen riktiga mening på att de icke ha tillräckligt stora fria branter, äro därför för mycket täckta av nedifrån uppskjutande träd, för att vid skogseldarna någon vegetation på dem skall kunna räddas. Och skogseldar ha här icke varit sällsynta, spåren visa sig litet varstädes i kolade både levande och döda stammar. I grankälar, vid stränder och på myrar räddas markvegetationen vid sådana olyckor av jordens fuktighet.

Grankälar och lövängsvegetation.

Trots blåbärsris, duvkulla, ekorrbärsört, kovall, linnéa och *Pyrola*-arterna vilar det en allvarlig, tung, något dyster stämning över barrskogarna (och än mer över de gråa myrarna) i Lappland som

i södra Sverige. Det livar sinnet, när man kommer in i ett område i skogen med midsommarblomster, ormbunkar, stenhallon, älggräs: en så kallad grankäl, visande således en större, mjukare och saftigare bladmassa och kraftigare blomfärg. Och vilken tjusning, om man plötsligt träder ut ur skogen i solljuset på en åstrand, blå av violer eller midsommarblomster eller tätört och skär av åkerbärsblom eller kanelros eller doftande vändelört (*Valeriana*) eller bärande älggräs eller liljekonvaljer, allt åtföljt av en frodighet av mjukt saftgrönt gräs och överskuggat på försommaren av blommande rönn och hägg jämte alderns och björkarnas grönska! På eftersommaren blommar där gullriset och en del hökfibblor och lysa tibastens eldröda bär. Utom åstränder, partier av sjöstränderna oeh marken längs bäckarna är det vissa myllsvackor i skogen och vattenrik skogsmark, som sluttar, alltså jord, genomträngd av ovan- eller underjordiskt rörligt vatten, som bär denna flora. Ja, blott en myr sänker sig ned till en annan eller till en sjö, så att vattnet kommer i strömning, kan stundom vegetationsförändring i denna riktning inträda.

För att få se sådan flora kan man fortsätta utmed Tjamstans sydsida åt öster.

Den fuktigare Tjamstansluttningen

öster om branten med blockhavet uppvisar eroderade grunda sänkor, kring vilka nedsipprande vatten underhåller yppig mossrik granskog med rik örtflora, ett av de rikaste naturliga vegatationsområdena i socknen. (Här skrapar man ihop mylla till Kyrkbyns krukväxtodling.) Inget naket berg, ingen blockmark synes, allt är dolt av mossor, örter, ris och skog. Om granskogen säger revirförvaltaren, att den icke gör intryck av lapsk utan erinrar om södra Sveriges.

a. Den första sänkan från väster räknat. — Den saknar egentlig bäck, endast efter starkt regn framträder på ytan en sipprande liten rännil. Här växa små *Alnus incana*-buskar, knappt mer än 2 m höga, *Juniperus, Rubus idaeus,* någon enda *Salix nigricans* och sparsamma *Daphne mezereum* samt

Achillaea millefolium
Agrostis tenuis
Calamagrostis purpurea
Carex digitata
Cerastium caespitosum
Crepis paludosa
Cystopteris fragilis
Dryopteris Linnaeana
» *phegopteris*
Equisetum pratense
Filipendula ulmaria
Fragaria vesca

Geranium silvaticum
Gnaphalium silvaticum
Habenaria viridis
Hieracium silvaticum-form
Leontodon autumnalis
Lycopodium annotinum
Melampyrum pratense
» *silvaticum*
Melica nutans
Orchis maculata
Paris quadrifolia
Parnassia palustris
Pinguicula vulgaris
Pyrola media
Pyrola minor
» *secunda*
» *uniflora*
Ranunculus repens
Rubus saxatilis
Solidago virgaurea
Stellaria graminea
Taraxacum croceum
Trientalis europaea
Vaccinium myrtillus
» *vitis idaea*
Veronica officinalis (rikl.)
Viola Riviniana (rikl.)

Överst, dels i fåran under alarnas och upprännande unga aspars lövvalv, bland hallonbuskar och med *Mnium* sp. på bottnen, dels på östra sidan om den i en parallell ränna utan synligt vatten

Actaea spicata
Galium triflorum
Milium effusum
Triticum caninum

Viola och *Galium* äro här yppigare och rikare blommande än på förutnämnda torrare grund.

Denna fåra har icke blott grankäls- utan tillika sydbergs-karaktär. *Galium triflorum, Milium, Veronica officinalis* och *Viola Riviniana* förekomma nämligen endast här på Tjamstan (*Veronica* skall enl. B. också finnas på Fnöskberget, möjligen på Habakpartiet, förf. har icke funnit den). Av *Actaea* har å annan lokal endast träffats 1 ex. i grankäl på östra skifferområdet (J. E. W.!). *Daphne* är däremot i Malå ingen sydbergsväxt, den är minst lika vanlig i andra grankälar. *Viola Riviniana* finns närmast i Falkberget vid Skellefte (Melander), dess nordligaste bekanta förekomst i kustområdet. I Lappland är den förut endast träffad på ett ställe nämligen i sydberget Kanisvaratj vid Lulevattnet av Frödin.

Nedom den grunda ravinen är det nedsköljda materialet utbrett i en öppning i skogen såsom en låg torr ackumulationskägla med *Antennaria dioica, Erigeron acris, Fragaria vesca, Rubus idaeus* och *Trifolium repens.*

b. Andra bäcksvackan på Tjamstans sydsida. — Denna, helt nära öster om den första, påvisades 1926 av jägmästare Nylander. Den börjar liksom den förra nedom bergets brantare överdel men med mindre lutning och för mera vatten, synligt på ytan, på ett stycke rent av bildande kärr. Yppigt mosstäcke i skogspartierna

med *Hylocomium proliferum* och *triquetrum;* i mitten, markerande själva vattenrännan, en storbladig *Mnium*-art. Gran, glasbjörk, gråal, rönn, hägg (sparsam), hallon (sparsam), en, tibast. Här saknas, tydligen till följd av den större fuktigheten, *Actaea, Carex digitata, Galium triflorum, Milium* och nästan alldeles *Viola Riviniana* men finnas f. ö. samma örter och ris, som uppräknats för den första fåran, och därjämte.

Anthriscus silvestris (steril)
Athyrium filix femina
Carex canescens
» *flava*
» *globularis*
» *Halleri*
» *loliacea*
» *magellanica*
» *vaginata*
Cirsium heterophyllum
Convallaria majalis
Deschampsia caespitosa
Epilobium palustre
Equisetum silvaticum
Eriophorum augustifolium
Linnaea borealis
Listera cordata
Lycopodium selago
Mulgedium alpinum
Potentilla erecta
Ranunculus lapponicus
Rubus chamaemorus
Selaginella spinulosa
Valeriana sambucifolia

varav kan utläsas markens vattenrikedom. Det är således en blandad grankäls- och kärrvegetation.

Veronica officinalis finns här endast långt ner, sparsam på där torrare grund. *Anthriscus*, en alldeles enastående, underlig förekomst, högst uppe; 5 svaga sterila individ i den våta mossan. Möjligen avlämnad av betesdjuren på denna för densamma onaturligt våta ståndort? Ett ensamt ex. därbredvid av *Rumex acetosa* måste ha kommit dit på det viset. Men varför ha då djuren icke på något enda annat ställe fört ut den vid uthusen vanliga *Anthriscus*?

I ännu något östligare grankälsmark nedom skarpaste branten finnes i *Hylocomium triquetrum*-matta tillsammans med *Alnus incana* m. l. m. av samma vegetation med *Actaea* och *Corallorrhiza trifida.*

c. Skogsmarken nedom de två fårorna. — Denna utgöres dels av kärrmark med *Salix phylicifolia* och *S. glauca,* dels av myllrik och väl vattnad örtrik granskog med för trakten ovanligt utsträckt yppig undervegetation av

Antennaria dioica
Athyrium filix femina
Carex digitata
Cirsium heterophyllum
Crepis paludosa
Cypripedium calceolus (3 ex.)
Daphne mezereum
Dryopteris Linnaeana
» *phegopteris*
Epilobium lactiflorum
Equisetum scirpoides
Filipendula ulmaria
Geranium silvaticum
Gnaphalium silvaticum

Goodyera repens
Gymnadenia conopsea
Habenaria viridis
Hieracium silvaticum-form
Orchis maculata
Paris quadrifolia (sälls.)
Parnassia palustris
Pyrola secunda
Pyrola rotundifolia
» *uniflora*
Rubus idaeus
» *saxatilis*
Saussurea alpina
Selaginella spinulosa
Vaccinium myrtillus
Veronica officinalis

Carex digitata har här nere i skuggan tydligt spetsiga axfjäll. *Equisetum scirpoides* upprät, 3—4 dm hög. *Cypripedium* steril 1929, då den upptäcktes; två av stånden hade två stjälkar.

I denna mark, nedom fåran a., fann i augusti 1923 magister Forke tre blommande skott av *Epipogium aphyllum*. I augusti 1927 blommade den enligt hans uppgift åter. Även den kalla sommaren 1928 påträffade jägm. Nylander nära intill 11 blomskott, och den ingalunda bättre nyss gångna 1929 fann han några och förf. 6, därav 5 i en tät klunga.

I samma skogsmarker finner man ock sparsamt *Achillaea millefolium, Chrysanthemum leucanthemum och Ranunculus acris;* de äro liksom *Trifolium repens* ditplanterade av boskapen, som årligen går där. (Vesterlund anser *Trifolium repens* ursprunglig i Jokkmokk. Förf. kan icke för Malås vidkommande biträda den åsikten.)

d. Grankäl i mossrik barrblandskog på skiffergrund mellan Bränne (kartans Näsberg) och Skäppträskån.

Alnus incana
Calamagrostis purpurea
Carex capillaris
» *Halleri*
Cirsium heterophyllum
Convallaria majalis
Daphne mezereum
Deschampsia flexuosa
Dryopteris Linnaeana
Epilobium angustifolium
Equisetum pratense
Festuca rubra
Filipendula ulmaria
Geranium silvaticum
Hieracium sp. (*silvat.*)
Juniperus communis
Leontodon autumnalis
Majanthemum bifolium
Melandrium dioicum
Melampyrum pratense
» *silvaticum*
Melica nutans
Paris quadrifolia
Poa alpigena
Pyrola rotundifolia
» *secunda*
Ranunculus acris
Rubus saxatilis
Saussurea alpina
Solidago virgaurea
Sorbus aucuparia

e. Grankäl i mossrik granskog mellan Brännträskliden och Rakkejaurheden (i östra delen av socknen).

Angelica silvestris
Calypso bulbosa
Cirsium heterophyllum
Crepis paludosa
Daphne mezereum
Dryopteris phegopteris
Epilobium Hornemanni
Equisetum pratense
Filipendula ulmaria
Fragaria vesca
Geranium silvaticum
Gnaphalium norvegicum
Linnaea borealis
Majanthemum bifolium
Paris quadrifolia
Pyrola minor
» *secunda*
» *uniflora*
Rubus arcticus
» *saxatilis*
Selaginella spinulosa
Trientalis europaea
Vaccinium vitis idaea
Valeriana sambucifolia
Viola epipsila

Det var jägmästare Wretlind, som 1923 här på ett större område fann riklig förekomst av den för befolkningen ganska obekanta *Calypso* och följande året likaså mellan Näsberg och Skäppträskån. Den var förut sparsamt känd från Släppliden i socknens västra del (B. bekräftat av J. E. W.), och från skogssluttningen mot Malån mittför Strömfors. Endast under blomningstiden i juni kan man få syn på den; sedan är den som försvunnen. 1927 träffades den rikligt, dels i öster vid Kvarnberg på nordsluttningen mot Malån (N.!) och dels mellan Skidberget och Skellefte älv (i socknens östkant) av jägm. C. A. Axelsson; i centrum söder om övre Skäppträskån, 6 km ovanför Skäppträsk, av jägm. C. Sandström (enl. N.). Den förekommer således både på skiffer- och massformiga bergarters grund.

Fragaria vesca finnes f. ö. endast på Tjamstans sydsida, i grankälar och bäckfåror på skiffern i öster och på en ö i övre Malån (N.). På Tjamstan plockades rikligt mogen frukt 23 juli 1923 (då sommaren dock kommit sent); 1928 först i början på augusti (tidig men enastående kall sommar). I allmänhet synes den vara en för befolkningen okänd växt (J. E. W.). Jordgubbsodling förekommer dock på några ställen men lider hårt av vintrarna.

f. Nedre delen av Nordberget NO om Tjamstan. — Här förekommer på sydvästra sidan så utsträckt grankälsvegetation på cirka 1 hektars yta, att man kan tala om örtrik björkskog med gran. Där finnas: asp, gråal, sälg, rönn, tibast och de vanliga grankälsörterna.

g. *Cypripedium*-trakten. — Särskilt omnämnande förtjänar Skellefteskifferområdet i öster, på vilket förf. redan varit inne under avd. Sydberg. Med *Cypripedium*-trakten menar förf. den del därav,

som ligger mellan Bränne (= kartans västligare Näsberg) och Näsberg och Näsliden i söder och Skäppträskån i norr. (Det är här grankäl d. finnes.) Från de båda sjöarna Fisktjuvträsk [kartans Fiskutr.; fisktjuv = fiskgjuse (J. E. W.)] gå avloppsbäckar ned till Skäppträskån. Skogsmarken (nyligen i stor utsträckning kalhuggen och bränd) ligger högt över denna flod, lär utgöras av ändmoränbildningar och är djupt eroderad av dessa bäckar och deras tillflöden från sidorna. I backarna framkomma nämligen källor, vilkas vatten genom öppna eller mossfyllda rännilar strömmar ned till bäckarna. I dessa fåror finns rik grankäls-bäckvegetation, men till de vanliga elementen däri kommer särskilt här

Carex capillaris
» *capitata* (i mosse)
Cirsium palustre
* *Cypripedium calceolus*
* *Cystopteris montana*
* *Epilobium davuricum*
Equisetum variegatum (mosse)
* » *scirpoides*
* *Eriophorum opacum*
Fragaria vesca
* *Melandrium dioicum* (*rubrum*)
Rumex acetosa

De med * betecknade äro icke funna annorstädes utom *Equisetum scirpoides* och *Cypripedium* (3 ex.) nedom Tjamstan; *Epilobium davuricum* finns även längre österut på skiffern. — Vid ett avloppsdike från en myr, fört in i en av dessa bäckar, på uppgrävt grus *Calamagrostis epigejos.* I ett parti utgjordes våtmarkens buskar uteslutande av *Salix phylicifolia* × *nigricans. Carex capillaris* är vanlig på åraningar men icke vid skogsbäckar. *Cystopteris montana* står i mossan i det kalla vattnet vid själva källorna; *Epilobium davuricum* i småränilarna tillsammans med blommande *Cardamine pratensis; Equisetum scirpoides* utbredd på till underlaget smetad mossa, bärande spår av översilning av vårvattnet; *Rumex acetosa* i den yppiga ängsfloran utmed den västligare Fisktjuvträskbäcken. *Cypripedium* växer icke vid de egentliga bäckarna utan i deras upphov, den av källvattnet fuktade marken högre upp eller i allmänt vattenöversilad blötmark med dess grankäls-bäckvegetation. Den upptäcktes först av numera överjägmästaren Gösta Borg, som på 1890-talet tjänstgjorde i reviret, och den uppträder på flera ställen inom det begränsade området; en av fyndplatserna, påträffad 1928 av jägm. Nylander, ansågs av honom hysa c:a 70 individ. Den bildar mogen frukt. (Av gammalt känd från Stensele, VSV om Malå.)

Ovanför dessa med saftig grönska fyllda fåror bär marken vanlig mager torr barrskogsundervegetation: bärris och *Deschampsia flexuosa,*

men skogen utgjordes av barrblandskog av hög kvalitet, den bästa, som produceras i reviret, med rikligt av reslig björk (N.).

De allra vanligaste karaktärsväxterna för grankälarna, angivande förefintligheten av rörligt vatten i grunden, äro *Dryopteris Linnaeana*, *Geranium silvaticum*, *Melica nutans* och *Rubus saxatilis*.

Någon skillnad finnes egentligen icke mellan grankäls- och b ä c k d a l s vegetationen. *Actaea, Calypso, Cypripedium* växa dock i c k e längs bäckarna. *Mulgedium alpinum, Athyrium filix femina, Carex Halleri* och *loliacea* äro däremot speciella bäckkantsväxter.

Å s t r ä n d e r n a,

om vårarna översilade av det rinnande vattnet, ha i olika partier olika karaktär. Somligt är myrmark, somligt mer fast, av människohand från buskar och träd frilagd, naturlig (= osådd) gräsmark, slåttermark, kallad liksom i Sorsele r a n i n g (ronning av Melander). Somligt är stenigt, vanligen m. l. m. träd- och buskbevuxet, ibland rikt på höga fristående *Carex juncea*-tuvor. Man löper där fara att köra ned fötterna i vattenhålorna mellan trädens rötter eller falla ikull med *Carex*-tuvorna. Det kallas s k r a v e l- eller s k r a p p e l ä n g. Dessa båda sista sorter är det, som bär den lövängsartade vegetationen och som här behandlas.

Såsom exempel på floran må anföras vad som antecknades 17 juli 1926 under vandring längs Malåns norra strand i socknens västra del ovanför gården Tallberg. Södra strandens vegetation såg ut att vara likartad.

Alnus incana
Betula »pubescens»
Daphne mezereum
Prunus padus
Rosa cinnamomea
Sorbus aucuparia

samt följande örter, företeende en blandning av kärr- och lövängselement:

Alchemilla alpestris (sälls.)
Angelica silvestris
Bartsia alpina
Calamagrostis purpurea
Carex Goodenowii * *juncea*
» *capillaris* (ymnig)
» *dioica*
» *flava*
» *panicea*
» *polygama*
» *rostrata*
Cirsium heterophyllum
Crepis paludosa
Convallaria majalis
Deschampsia caespitosa
Equisetum pratense
Filipendula ulmaria
Galium palustre
Geranium silvaticum
Hieracium chloromelanum?
Hierochloe odorata
Leontodon autumnalis

Melampyrum silvaticum
Melica nutans
Menyanthes trifoliata
Parnassia palustris
Pinguicula vulgaris
Potentilla erecta
» *palustris*
Pyrola minor
Ranunculus acris
» *auricomus*
Rhinanthus minor
Rubus arcticus
» *saxatilis*
Saussurea alpina
Scirpus alpinus
» *caespitosus*
Solidago virgaurea
Thalictrum flavum
Tofieldia palustris
Valeriana sambucifolia
Viola montana
» *epipsila*

Tillika sådana torrmarksväxter som

Achillaea millefolium
Antennaria dioica
Hieracium "silvaticum"

Från senare besök, utsträckta längre uppåt och nedåt ån, äro att tillägga

Agrostis borealis
» *tenuis*
Barbarea stricta (sälls.)
Cornus suecica
Euphrasia minima
Hieracium dolabratum
» sp. *(rigid.-sparsif.)*
» *angustum*
Poa nemoralis (sälls.)
Rhamnus frangula
Ribes pubescens
Rubus saxatilis × *arcticus*
Sceptrum Carolinum
Scutellaria galericulata
Selaginella spinulosa
Triticum caninum

På en ö här i ån träffades som nämnt 1929 *Fragaria vesca* (N.).

Rökån

i socknens sydspets har vackra raningar med den på sådana vanliga lövängsfloran:

Alnus incana
Betula sp.
Juniperus communis
Prunus padus
Rhamnus frangula
Rosa cinnamomea
Sorbus aucuparia

och örterna

Achillaea millefolium
Agrostis tenuis
Angelica silvestris
Carex flava
» *tenuiflora*
Cirsium heterophyllum
Convallaria majalis
Crepis paludosa
Filipendula ulmaria
Hieracium chloromelanum
» cfr *angustum*
Hieracium helveolum
Leontodon autumnalis
Majanthemum bifolium
Melica nutans
Paris quadrifolia
Parnassia palustris
Rubus arcticus
» *saxatilis* (o. hybr.)
Saussurea alpina
Solidago virgaurea
Viola epipsila

Här saknades *Carex capillaris* och *Viola montana*. I stället tillkommo *Luzula sudetica* och *Salix myrtilloides* från tillgränsande stor myrmark.

Vormbäcken,

nära föregående, har mycket myrstränder men även något »skrappelmark» med vanlig lövängsvegetation, där dock likaså *Viola montana* synes fattas, men i stället tillkommer *Cirsium palustre*.

Malåns nedersta stycke.

Jämte förut under sydberg omtalade särskilda växter och de vanliga raningsarterna i rik utveckling märkas här

Calamagrostis lanceolata *Galium boreale* (rikl.)
Carex pallescens (rikl.)

Galium likaledes vid nedersta Skäppträskån. Melander framhåller, att den i östra Lappland endast finnes »vid åarna, sjöarna och på fuktiga lokaler nedom bergväggar». I Malå som ursprunglig endast här nere mot landskapsgränsen.

* * *

Det gör ett egendomligt intryck att på stränderna se liljekonvalje och backviol (*Viola montana*) på de litet högre partierna, stundom = buskarnas rotvalv, sida om sida med kråk- och vattenklöver, björnbrodd *(Tofieldia)* och flaskstarr *(C. rostrata)*.

En med raningarnas och skravelmarkens likartad lövängsvegetation träffas stundom på sjöstränder, karakteriserad av *Calamagrostis purpurea, Cornus suecica, Filipendula ulmaria, Rosa cinnamomea, Rubus arcticus, Valeriana sambucifolia.*

Åströndernas flora är, som synes, väsentligen densamma som i grankälar och vid bäckar, dock saknas *Melandrium dioicum* och *Eriophorum opacum,* som äro helt lokala i socknen.

Visst icke alla bäck-, å- och älvstränder visa denna särskilda lövängsflora, det ges även nog så magra stränder. Somligstädes är det som nämnt blott myr, somligstädes går skogen ända fram till vattnet. Skellefteälven i övre delen bjuder på magra, fattiga ständer: *Carex rostrata, vesicaria* och *juncea, Ranunculus reptans, Cardamine pratensis* (steril), *Caltha, Alopecurus aequalis* (flytande), *Subularia*. Först nere vid Grytforsen äro de tillfälligt något rikare och

sedan vid Sandfors. Där uppträder *Baldingera arundinacea*, som annars saknas i Malå. Malåns stränder äro de rikaste.

* * *

Samlar man ur ovanstående listor tillhopa de växter, som, åtminstone i regeln, icke förekomma annat än på dessa lokaler, får man följande

grankälarnas och lövängssträndernas särflora.

k = förekomst vid källor och deras avlopp; b = d:o vid bäckar; å = d:o vid åar, älvar och sjöar; g = d:o i grankälar.

Actaea spicata		g			*Epilobium lactiflorum*		g	b		
Alchemilla alpestris				å	*Epipogium aphyllum*		g			
Alnus incana		g	b	å	*Equisetum scirpoides*	k	g	b		
Angelica silvestris		g	b	å	*Eriophorum opacum*			b		
Athyrium filix femina			b		*Filipendula ulmaria*		g	b	å	
Baldingera arundinacea				å	*Fragaria vesca*		g	b		
Barbaraea stricta	k			å	*Galium boreale*				å	
Bartsia alpina				å	» *palustre*				å	
Calamagrostis lanceolata				å	*Geranium silvaticum*		g	b	å	
» *purpurea*		g	b	å	*Habenaria viridis*		g			
Calypso bulbosa		g			*Hieracium angustum*				å	
Cardamine pratensis		g	b	å	» *chloromelanum*				å	
Carex capillaris			(b)	å	» *dolabratum*				å	
» *digitata*		g			» *helveolum*				å	
» *flava*			b	å	*Hierochloe odorata*				å	
» *Halleri*		g	b		*Lysimachia thyrsiflora*				å	
» *loliacea*			b		*Melandrium dioicum*		g	b		
» *tenuiflora*		g		å	*Orchis maculata*		g	b		
Cirsium heterophyllum		g	b	å	*Paris quadrifolia*		g	b	å	
» *palustre*			b	å	*Pedicularis sceptrum Carolinum*				å	
Convallaria majalis		g		å	*Poa alpigena*	k		b		
Cornus suecica		g	b	å	» *nemoralis*				å	
Crepis paludosa		g	b		» *palustris*				å	
Cypripedium calceolus	k	g			*Pyrola*-arterna utom *chlorantha*		g			
Cystopteris montana	k				*Ranunculus acris*		g	b	å	
Daphne mezereum		g	b	å	» *auricomus*				å	
Dryopteris Linnaeana		g	b		» *lapponicus*			b		
» *phegopteris*		g	b		» *repens*			b		
» *spinulosa*		g	b		*Rhamnus frangula*			b	å	
Epilobium alsinifolium	k				*Ribes pubescens*				å	
» *anagallidifolium*			b		*Rosa cinnamomea*				å	
» *davuricum*	k		b							
» *Hornemanni*	k	g	b							

Rubus arcticus	g	å		*Scutellaria galericulata*			å
» *saxatilis*	g	b	å	*Thalictrum flavum*			å
Salix cinerea			å	*Valeriana sambucifolia*	g	b	å
» *nigricans*		b		*Veronica scutellata*			å
» *pentandra*		b	å	*Viola montana*		b	å
Saussurea alpina	g	b	å				

Anm. — Några få av dessa finnas dock även i den torra Tjamstanbranten: *Convallaria, Fragaria, Poa nemoralis, Rubus saxatilis, Viola montana.* — *Bartsia, Pedicularis sceptrum Carolinum, Salix cinerea* och *S. pentandra* någon gång i kärr, hieracierna (utom *H. helveolum*) på hemängarna.

Grunden till ovan skildrade lokaliteters större växtrikedom måste vara av edafisk natur: ständig tillgång på syrsatt vatten, frånvaro av humussyror, rikare belysning (sjö- och åstränder). Sedimentation spelar nog också indirekt en roll eller har åtminstone förut så gjort. För närvarande erodera åarna snarare, tyckes det; det kommer sig av uppdämningen på vintern i och för timmerflottningen; när den är över vid midsommar, släppes vattenmassan hastigt ut (J. E. W.). På en del ställen synes dock sandavlagring; det märkes ock av strandbrinkens fasthet på somliga lokaler, där marken f. ö. är myr, såsom vid Rökån, där under grästorven låg röd sand. Härigenom beredes existensmöjlighet för fastmarksväxter.

Sydliga relikter.

Utom de sydbergs- och skiffergrundsväxter, som äro att räkna såsom kvarlevor från värmetiden: *Actaea, Anthyllis, Carex digitata, Epilobium collinum, Galium triflorum, Hypochaeris maculata, Polypodium vulgare, Potentilla argentea, Veronica officinalis, Viola Riviniana,* må anföras följande.

Rhamnus frangula

förekommer i socknens nedre del, närmast Västerbotten, t. ex. vid Fisktjuvtjärnbäcken och Skäppträskån, likaså vid Malån och Rökån i överensstämmelse med Andersson och Birgers utbredningskarta. Men den finns även på öar i Malåträsk (B. !) 3 km V om Kyrkbyn, där den står bland *Salix glauca*, som bildar strandsnår på de högre, av röd sand byggda delarna av det fria bältet utanför furuskogen, som upptar öarnas högsta delar. (Sanden bär f. ö. *Calluna, Molinia* och den i Malå sparsamma *Hieracium umbellatum.*) Som

förut omtalat återkommer *Rhamnus* vid övre Malån, ja, enligt herrarna Gaunitz fortsätter den upp till Gargnäs i östra Sorsele. (Enligt Vesterlund och enligt Th. Arwidsson i Bot. Not. 1927 finns den vid Lule älv ovan polcirkeln.)

Pteris aquilina

anträffades 1925 och 1926 på ett par ställen inemot Västerbottensgränsen (J. E. W.) och 1928 i den närbelägna *Cypripedium*-trakten (N.). Sådana reliktförekomster äro ock kända i Lycksele och Jokkmokk.

Mer uppseendeväckande är förekomsten i socknens övre, västra del, inemot Sorselegränsen, norr om byn Holmsjö av

Myrica gale,

ungefär 12 mil väster om dess av Andersson och Birger utsatta gräns (mellan Skellefte och Bastuträsk). I Bygdeå kustsocken, 8 mil söder om Skellefte, förekommer den högst 2 mil in i landet (Grapengiesser 1926). Den påträffades vid slåtter av lantbrukaren G. Elof Mörtsell (B.). På begäran tillsände han benäget förf. pressade fruktificerande kvistar och meddelade, att den växer »vid Verbobäcken, mera sparsamt vid själva strandbrädden men ymnigare vid den vattennivå, som bäcken vid flodtiden stiger till». Denna bäck kommer från Verbosjöarna i Sorsele och löper på här ifrågavarande ställe mitt i en lång slåttermyr, vilket väl förklarar porsens ymnigare förekomst vid dennas kant, flodtidsstranden. (Andra isolerade fyndorter inne i Lappland äro enl. Andersson & Birger Svappavara i Torne lappmark och Kroksjö i Åsele lappmark, 4 mil SV om Lycksele kyrkplats.)

Alpina element.

Något fjäll finns icke i Malå. Högsta berget, Fnöskberget, 620 m ö. h., är bevuxet med granblandad björkskog vid toppen. I socknens nordspets ser man det närmaste fjället [dock saknande fjällflora (N.)] alldeles inpå sig men på andra sidan Skellefte älv, i Arvidsjaurs socken.

Liksom överallt i övre Norrland förekommer i Malå allmänt en hel del växter, som man i södra Sverige är van att betrakta som fjällväxter: *Phleum alpinum, Carex Halleri, Eriophorum Scheuchzeri, Tofieldia palustris, Salix phylicifolia, glauca* och *lapponum, Epilobium*

Hornemanni och *lactiflorum, Saussurea alpina, Gnaphalium norvegicum* (som växer i blandning med *G. silvaticum). Poa alpina* är allmän på lägdorna, *Eriophorum opacum* förekommer på östra skifferområdet. Rätt sällsynt är *Petasites frigidus,* på enstaka ställen i bäckar. — I en kraftig kallkälla (temp. +3°,2 C.) uppe på Fårbergets (vid Malåträsk) nordsida växer i det flytande *Brachytecium rivulare*-täcket typisk *Epilobium alsinifolium*, likaså i en källa i vägkanten nära 8 km öster om Kyrkbyn (tillsammans med *Barbaraea stricta* och *Poa alpigena)* samt i en källa S om Lakaträsk (N.), säkerligen på ännu flera ställen. På Fnöskberget, intill byn Bergnäs, finns i en fuktig vårbäcksfåra vid skogsvägskanten, delvis *Sphagnum*-fylld,

Epilobium anagallidifolium

(tillsammans med *E. Hornemanni*, *lactiflorum* och *palustre*). *Epilobium davuricum* och *Cystopteris montana*, se grankälar och bäckstränder g. — *Gnaphalium supinum* talrikt på en mindre fläck på gångstig på stenig moränbacke i skogen ca 2 km S om Svidjan (=S. Fårträsk) och uppe på Hornberget (N.). (Förf. har tidigare sett den på annat ställe, då stjälken icke varit utvuxen, och hållit den för förkrympta individ av någon av de andra arterna, varför lokalen icke antecknats.)

Lycopodium alpinum i Adaks by (5 mil från fjällvärlden) på ett oomvandlat naturparti i en hemslåtteräng på byhöjdens sluttning, alldeles begravd i omgivande mossa, så att nätt och jämt kortskottspetsarna nådde den fria ytan. (Samuelsson fann den i Dorotea på ljungrik tallhed knappa 2 mil från fjällområdet.)

Mulgedium alpinum, som lapparna sagt Melander skola saknas i Malå, finns mångenstädes på kallkällmark och vid bäckar. — *Gentiana nivalis,* några få exemplar i den blomsterrika gräsbacken på en gårdsplats i Rentjärns by 1928; var kanske tillfällig. — *Poa glauca* och *Viscaria alpina*, se sydberg. Den senare är ock anträffad vid Vågträskbäckens inflöde i Skellefte älv (N. !) och vid Grytforsen, längre ned i samma älv (J. E. W.). Med fjällälvarna pläga ju följa fjällväxter nedåt landet. Så omtalar Melander *Astragalus alpinus* vid Skellefte älv nere i Västerbotten (Norsjö) och *Aconitum* på två ställen vid densamma nedåt Skellefte stad. Men underligt nog har ingendera blivit sedd i Malå. Malån rinner upp i skogslandet i Sorsele, likväl finns *Bartsia* vid den liksom vid dess bia

Bockträskbäcken, även den kommande från östra Sorsele, och *Euphrasia minima*. Fjällbjörk, *Betula tortuosa*, ingår i de björkar, som bilda skogen på åtminstone Fnöskbergets hjässa (620 m). Kvistarna och bladen vittna därom, stammarna däremot äro raka med grov, hård, gråvit näver med väldiga lenticeller.

Genom människan och åkerbruket införda växter.

Bland det mest intressanta för en sydsvensk florist i denna ödemarksbygd är att här ännu är »landnamstid», man ser, hur den ursprungliga växtvärlden tog sig ut, och får riktigt upp ögonen för hur ofantligt mycket kulturmänniskan med sin samfärdsel, sitt åkerbruk och sin boskapsskötsel positivt betyder för vår nuvarande floras sammansättning; för huru mycket av »våra vanliga vilda växter», som egentligen har oss själva och våra husdjur att tacka för sin tillvaro här eller åtminstone sin stora utbredning. Det är icke blott åkerogräsen det gäller, utan därjämte en hel del andra, som jämte en del av de förra spridas kring husen, på ängen, längs vägarna och stigarna och i utmarkerna av oss själva och de betande husdjuren. (Kulturens motsatta, negativa betydelse på andra orter både genom uppodling och betning därmed naturligtvis ingalunda förbisedd.) Man vet ju detta så väl förut teoretiskt, men det blir på ett annat sätt levande och verkligt här, där den odlade jorden är så obetydlig mot det övriga, och förvandlingen alltjämt börjar oeh pågår inför ens ögon. [Jfr E. Almquist, Upplands vegetation och flora. Hur många ha tänkt sig, att såsom där framställes, t. ex. *Pulsatilla vulgaris, Herniaria glabra, Achillaea ptarmica* ha till större eller mindre del människan att tacka för sin tillvaro där?]

Människor uppträdde i Malå redan under bronsåldern. Huruvida de varit bofasta och idkat åkerbruk, vet man icke, enär ingen forskare undersökt lämningarna efter dem. Vid klimatförsämringen övergavs åtminstone detta inland, och i senare tider voro lapparna ensamma herrar på täppan. T. o. m. de tros ha lämnat trakten (belägenheten av äldre urkunders lokalnamn är okänd) efter, som man förmodar, stora skogseldar på 1600-talet (träd, äldre än 260 år, förekomma i regeln icke). (Ovanstående meddelat av J. E. W.) Några synliga minnen i vegetationen från ett eventuellt jordbruk efter mer än 2,000 års mellanrum kan man knappast vänta.

Den nya epoken börjar år 1770, då av kronan jord upplåts åt de första nybyggarna. De ha sedan ökats och jordbruket med dem, och utvidgningen pågår alltjämt. Från början grundade sig nybyggarnas existens till väsentlig del på kreaturen, som underhöllos genom myrslåtter, lövtäkt och skogsbete. Numer är skogen själv huvudnäringskällan, men det lilla jordbruket drives fortfarande såsom binäring, hur litet lönande det än är. Man behöver ju mjölk och grädde och odlar för djuren havre (till grönfoder), gräs och klöver; av gammal vana ock för sig själv korn (och ibland litet råg). Potatis, tung att frakta och icke tålande transport under frost, produceras likaså på platsen. Därför ökas med befolkningen den odlade jordens areal både genom uppbrytning av moränmark och myrodling. Det här efter skattelängden som odlingsjord betraktade är dock till en del blott sällan eller aldrig plöjd men delvis gödslad och inhägnad slåttermark kring husen, en slags halvt naturlig äng, kallad l ä g d a. När plöjd mark besås till vall, sker det med bottenavfallet i ladorna och på foderborden (J. E. W.) eller nu i nyare tid med frö, erhållet av ett vid slåttern sparat gräsbestånd. Verkliga timotej- eller klöver-timotejfält förekomma också hos de mera välbärgade; stundom lika präktiga som söderut. Icke sällan vittnar dock en åkervegetation av helt obetydligt med timotej eller klöver men massvis baldersbrå, lomme, åkerspärgel och våtarv om ägarens fattigdom (eller slöhet?); klöver- och timotejfröet inköpes ju utifrån.

Åkergräset och en del vägkantväxter äro uppenbara såsom kulturmedförda, men det ges även en del ängs-, gångstigs- och strandväxter, som höra till denna kategori, nämligen

Alchemilla-arter
Alopecurus pratensis
» *geniculatus*
Anthoxanthum odoratum
Chrysanthemum leucanthemum
Juncus bufonius
Nasturtium palustre
Poa alpina
» *pratensis*
Prunella vulgaris
Sagina procumbens
Taraxacum-arter
Trifolium pratense
» *repens*
Veronica serpyllifolia
» *scutellata* ?
Vicia cracca

Härtill kommer, att dessa av ursprunglig skogsmark framgångna ängar bli nya områden för en del förut inhemska, men till en del sällsynta växter, såsom

Campanula rotundifolia — *Rhinanthus minor*
Cerastium caespitosum — *Stellaria graminea*
Erigeron acris

Osäkrare ställer sig saken rörande

Achillaea millefolium — *Rumex acetosa*
Carex festiva — » *acetosella*

Achillaea, som växer massvis på kulturjord, uppträder åtminstone skenbart fullt vild i gräsvallen vid åstränder och nedom Tjamstanuren. Men på de förra ställena färdas ideligen metare och timmerflottare och vid Tjamstan betesdjuren. Man finner den ock på skogsstigar långt från kulturjord, den kan tydligen medfölja människor eller djur. Birger upptar den i Kebnekajsetrakten, Simmons i Kiruna bland florans kulturelement, och Almquist anger den i självaste Uppland såsom till största delen synantrop. Så mycket sannolikare då här! — *Rumex acetosa*'s hemortsrätt i den ursprungliga floran vågar förf. icke alldeles bestrida. Ett ensamt ex. i Tjamstansvackan b, ett annat vid nedre Malån och ett vid Skellefte älv betyda föga ifråga om en så lättspridd växt (se i byarnas omgivningar!), men 1929 träffades flera ex. längs en av yppig vegetation åtföljd bäck i *Cypripedium*-området, och det säger något mera. — *Rumex acetosella* finns i Tjamstanbranten, även Andersson & Birger omtala den i sydberg. Den är allmän i kanten av gångstigar i torr ljus furuskog. Jämte *Matricaria inodora* är den en av de först uppträdande främmande växterna på nyanlagda vägar, även långt från bosättning. Dessa måtte alltså följa med arbetsredskapen eller arbetarna. Även på uppgrävd torvjord vid myrdiken kan man träffa dem. — *Carex festiva* anges i litteraturen såsom hörande till den andra gruppen ovan; i Malå har förf. emellertid icke funnit den annat än på lägdorna, där den är vanlig. — Samma är förhållandet med *Anthoxanthum* och *Poa alpina*.

Veronica serpyllifolia går visserligen något utåt sidorna från de av människan trampade jordbitarna såsom på sjöstränderna vid båtlänningar, men icke långt stycke. Går med på skogsstigarna vid fuktiga ställen. Fuktig mark älska liksom den *V. scutellata* och *Nasturtium palustre*, vilka icke heller träffats annorstädes än där folk trampar.

Chrysanthemum leucanthemum har förf. sett blommande under granar i skogen nedom Tjamstan, men ingen torde vilja utge den för en barrskogsväxt; betesdjur och människor ha sin stig där-

förbi. Melander påpekar, att Zetterstedt icke fann den i Lappland 1832, och anger själv några få lokaler i detta landskap, varav man kan sluta, att den, så pass vanlig som den nu är åtminstone i Malå, håller på att breda ut sig med kulturen, ty det är på dess ängar, som den uppträder.

Om *Vicia cracca* säger Smith (1920): »införd, täml. allmän». Det gäller fjällområdet i Jämtlands län, men visar, att den kan medfölja människan. Då denna xerofyt i Malå icke finns ens i sydbergen, är icke tänkbart, att den skulle vara ursprunglig på någon annan lokal.

Cerastium caespitosum, som förekommer dels som ogräs, dels icke så sällan ute i vildmarken i naturliga fuktiga växtsamhällen, t. ex. i *Cypripedium*-traktens bäckfåror, kan tänkas vara samtidigt både ursprunglig och införd med utsäde.

* * *

Som havren högst sällan mognar och stundom icke heller rågen eller kornet, till klöver- och timotejsådd alltid användes utifrån inköpt frö, och vid missväxt hö inköpes från andra orter, är här en bestående källa till nya ogräsväxters uppträdande. Likaså i någon mån genom trädgårdsfrö, då ettåriga prydnadsväxter börjat sås på sista tiden.

Av dessa sålunda införda växter visar sig en del blott tillfälligt och försvinner igen, andra kunna hålla sig kvar i ringa utsträckning i åratal utan att sprida sig, medan ännu andra bli väl inkorporerade, d. v. s. förekomma allmänt och beständigt, så länge jordbruket består. Gränserna kan vara svårt att draga, hittills tillfälliga kunna framdeles bli bestående.

Första gruppen. Tillfälliga arter.

Förf. vill alldeles utelämna dem ur den allmänna förteckningen, enär deras medtagande där ger en alldeles falsk bild av den verkliga floran. (I de först omtalade redogörelserna från Lappland i denna tidskrift äro sådana däremot medtagna.) Dit höra: *Achillaea ptarmica*, bland *Parnassia* på myraktig sjöstrand, i fullt naturlig miljö vid båtlänning (dock icke bärande spår av att vara mycket trafikerad) vid en gård i Brännäs; den fanns planterad vid en annan gårds husvägg i byn; likaså på våt äng vid Kyrkbyn nära sjöstranden (Olga Bergström!). *Brassica campestris* rikligt i råg i

Mörttjärn 1928; *Centaurea cyanus* (B.); *Agrostemma githago* (Olga Bergström!); *Cirsium arvense; Echium vulgare* (B.); *Fumaria officinalis; Galium verum* (B.!); *Gnaphalium uliginosum* (B.!) som sår sig år efter år, tycks det, vid ett hus i Kyrkbyn; *Lamium purpureum; Lapsana communis; Lepidium campestre* (N.!); *Linaria vulgaris* (ur trädgårdar); *Plantago lanceolata* (N.!); *Polygonum tomentosum*, f. *incanum* (sätter knappt frukt, om den ens blommar); *P. persicaria* (i blom i Hornbergs by $^{15}/_{8}$ 1929); *Primula veris* (Forke); *Rhinanthus major* (B.); *Senecio vulgaris* (sätter frukt); *Viola tricolor* d:o; *Vogelia paniculata* (B.; Olga Bergström!).

Apera spica venti är väl lika tillfällig här som i de mellansvenska landskapen; träffad i åkrar av både B. och förf.

Till vilken grupp man skall räkna den flerstädes här liksom överallt i landet numera kulturspridda *Thlaspi alpestre,* kan förf. icke avgöra. *Trifolium hybridum* kan någon enda gång uppträda förvildad.

Andra gruppen. Mindre allmänna men bestående eller med utsäde återkommande arter.

Anthemis tinctoria i klöver, går ut efter ett par år. *Arabis arenosa* (nyinkommen 1927?) blommade flerstädes 1928 men var sällsynt 1929; osäkert om den blir bestående. *Campanula patula, Galium aparine, Potentilla norvegica, Raphanus raphanistrum* och *Sinapis arvensis* (i havre och korn), *Sonchus arvensis* och *Viola arvensis* höra hit.

I gräsmark och på gårdstunen finnas på en del ställen följande lokalt kvarstående perenner:

Alchemilla acutidens eller *A. subcrenata* i kanske de flesta byar; *Dianthus deltoides* Strömfors (J. E. W.!); *Galium boreale* Kyrkbyn; *G. mollugo* Kyrkbyn, Rakkejaur; *G. uliginosum* Bergnäs, Fårberg, Sandfors; *Lathyrus pratensis* Kyrkbyn, Släppträsk; *Hieracium auricula* Kyrkbyn mellan prästgårdarna (B.!); *Plantago media* Hornberg (B.), Kyrkbyn på ett par ställen; *Saxifraga granulata* Hornberg (B.; N.); *Trifolium spadiceum* Kyrkbyn (Forke; förf.); *Urtica dioica* i 6 byar, ännu stationär där; *Veronica chamaedrys* Kyrkbyn på 2 ställen; *Mentha arvensis* i en slåtteräng österut i Kyrkbyn 1929, blommande (Olga Bergström!)

Tussilago farfara har inkommit dels i en myrodling vid Rentjärnberg (J. E. W.), dels i Brännbergs by.

Matricaria suaveolens (discoidea) inkom enl. Björzén 1918 eller 1919 och har utbrett sig i landsvägens kanter på 1 km:s sträcka från

Kyrkbyn västerut samt på en gårdstomt i byn. Alchemillorna, *Tussilago* och *Matricaria* ha en tryggad framtid.

Tredje gruppen. Fullt inkorporerade (allmänt förekommande, säkert införda) arter.

Alopecurus pratensis
» *geniculatus*
Anthriscus silvestris
Barbaraea vulgaris
Carum carvi
Chrysanthemum leucanthemum
Matricaria inodora
Plantago major
Poa pratensis
Prunella vulgaris
Rumex domesticus
Silene venosa
Taraxacum-arter
Trifolium pratense
» *repens*
Triticum repens
Vicia cracca

samt följande annuella

Capsella bursa pastoris
Chenopodium album
Crepis tectorum
Galeopsis tetrahit
» *bifida*
» *speciosa*
Juncus bufonius
Myosotis arvensis
Poa annua
Polygonum aviculare
» *convolvulus*
Spergula arvensis
Stellaria media
Thlaspi arvense

Man observere, att *Lamium purpureum* och *Senecio vulgaris* ännu blott äro tillfälliga! På en mer än 100-årig gård saknas ännu *Plantago major,* men så saknas också körväg dit. *Poa annua* var däremot allmän där; den växer även på skogsstigarna.

Carum carvi är ofta riklig på gårdstomter och hemängar, troligen ursprungligen avsiktligt utsådd (1929 sågs en säng kummin i en riktig hage). *Anthriscus silvestris* förekommer som den förra kring uthusen. *Prunella vulgaris* inkommer med klövern, syns i vallarna efter slåttern, sprider sig därifrån ut på vägkanter, i Kyrkbyn på sjöstranden, men långsamt.

Prydnadsväxter, bärbuskar m. m. vid bostäderna.

Träd: endast traktens egna bruka användas, mest björk, rönn och hägg.

Buskar: hallon, röda vinbär, kanelros. Vinbären lära oftast hämtas från Skattån, biflod till Skellefte älv på motsatta sidan (J. E. W.). Svarta vinbär sällsynta.

Utländska buskar: sibirisk ärtbuske (*Caragana arborescens*) mycket

allmän, trivs utmärkt; ungersk syren (*Syringa josikaea*); något mindre allmänt rosentry (*Lonicera tatarica*), häck-, kvast-, och rönnbladsspiréa (*Spiraea salicifolia*, *chamaedrifolia*, *sorbifolia*). Vanlig syren sällsynt, trivs icke, vill frysa ned, lär dock någon gång kunna blomma.

Örter: allmännast rabarber, gråbo (*Artemisia vulgaris*), den senare enligt Melander för medicinskt bruk, samt kvanne (*Angelica archangelica*). Denna härstammar väl från Sorsele eller Lycksele, där den växer vild längs Vindelälven ända ned till Ekorrsele i Västerbotten (Melander). Kännedomen om både dess inhemska namn och användning har gått förlorad trots befolkningens starka inslag av lappblod; man kallar den angélika. Även björnfloka (*Heracleum sibiricum*) får man se; kallas lebsticka (Forke). Verklig libsticka (*Ligusticum levisticum*) endast sedd vid Vännäs skjutsstation. Humle vid väggen sällsynt (Kyrkbyn, Hornberg). Ofta prydnadsörterna rödblära (*Melandrium dioicum*) och hög riddarsporre (*Delphinium elatum*); ibland nysört (*Achillaea ptarmica*) och smörbollar (*Trollius europaeus*); mindre allmänt ännu stormhatt (*Aconitum cammarum*). — På senare år ha införts och utbretts *Aquilegia*-former, *Linaria vulgaris* (från 1922 av J. E. W.), *Papaver nudicaule*, *Polemonium coeruleum*. Numera inkomma med den nya tiden (motortrafikens) allehanda nyheter av söderut brukade annueller: opiumvallmo, *Eschscholtzia*, *Eucharidium*, *Tropaeolum majus* m. m.

Artförteckning.

(Tillfälliga förekomster icke medtagna, se ovan sid. 84).

a. = allmän, t. a. = tämligen allmän, m. a. = mindre allmän.

Woodsia ilvensis sälls., i sydberg och springor i kalkhaltiga amfibolitblock (J. E. W.!). *W. alpina* i spricka i block vid Skellefte älv (jägm. Ossian Andersson!)

Cystopteris fragilis sälls.; som *Woodsia ilvensis*. *C. montana* sälls., se ovan sid. 73 (*Cypripedium*-trakten).

Dryopteris spinulosa m. a. vid skogsbäckar; rikligare på Fnöskberget och på sydsidan av Svartliden i våt grankälsmark med *Paris*, *Mulgedium* etc.; i skogen nedom Brännbergs by; solöppet bland sten på stranden av Brunträsket vid Vännäs och i vägkanten vid Rentjärns by; i grankäl (glacial bäckfåra) på Tjamstans västsida. *D. phegopteris* t. a. *D. Linnaeana* t. a.

Athyrium filix femina m. a. vid skogsbäckar: Tjamstan, Fnöskberget, östra skifferområdet.

Pteris aquilina mkt sälls. (Se sydliga relikter sid. 79.)

Polypodium vulgare sälls. Förekomst = *Woodsia ilvensis* och *Cystopteris spinulosa;* därjämte på nordbranten av Nordberget.

Botrychium lunaria sälls.: Tjamstanbranten; Skäppträskåns strandbank N om Näsbergsbrännan. Långträsks by. F. d. lappviste (*Festuca ovina*-äng) i Strömfors (J. E. W.!). På hemäng i Vännäs många kraftiga ex. — Sporspridning sker redan före eller vid slåttertiden (mitten l. slutet av juli), därför kan växten äga bestånd vid gårdarna. — *B. multifidum* (ternatum) på gammal lågvuxen gräsmark vid gårdarna. Sent utvecklad, först efter slåttern i augusti skjuter sporofyllet i höjden; som örtbladsdelen är tryckt intill marken, undgår den alltså lien. Kan därför heller knappast upptäckas tidigare. Kyrkbyn, mellan prästgårdarna, 4 ex. i en grupp, 33 i en annan; 46 ex. på äng bredvid jägmästarebostället. Hornberg, rikligt vid en av de gamla gårdarna.

Equisetum arvense a. Sandjord—*Sphagnum*-vegetation i källor. *E. hiemale* sälls. Används som skavgräs (skäfte). Dels å tallhed, dels i stenig källmark, dels i myr (J. E. W.). Flerstädes t. ex. på Jokkmokkliden (kronojäg. Andersson); vid Ljustjärn (Forke); N om Hornberg; bland buskar i myr vid Storforsen. — *E. limosum* a. i sjöar, åar, myrar, på dyjord; vanligen nästan utan kransgrenar. *E. palustre* a. *E. pratense* a. *E. silvaticum* a. *E. variegatum* (tenellum) sälls.: stenig vårflodsbiföra till Malån mellan Avaås och Tallberg; liknande lokal vid Skellefte älv nära Grytforsen; i en *Sphagnum*-backmosse i *Cypripedium*-trakten. — *E. scirpoides* sälls. (se grankälar).

Lycopodium annotinum a. En form på övergång till var. *pungens* med uppåtriktade blad på kortskotten men dessa lika höga och sporangieaxen lika långa som hos huvudarten har av Nylander tagits på Blausjaurliden och setts flerstädes. *L. clavatum* a. *L. complanatum* a. *L. alpinum* sälls. (se alpina element sid. 80). *L. selago* a. i myrar.

Selaginella spinulosa a. *Isoëtes lacustris* i Malåträsk, Malån, och på olika ställen i Skellefte älv.

Juniperus communis a. *Picea excelsa* a. *Pinus silvestris* **lapponica* a.

Sparganium minimum i åar, icke allmän, Adak, övre Skäppträskån, Springliden, Skellefteälvsavan vid Sandfors. *S. submuticum* t. a. *S. affine* a. i sjöar; även i flarkar (N.). *S. simplex* sälls. Övre Skäppträskån; östligast i socknen i en myrängså sågs i aug. 1928 en steril *Sparganium*, så kort- och bredbladig, att det måste vara denna art.

Potamogeton alpinus a. i åar och älvar. *P. gramineus* t. a. *P. natans* m. a. Malåträsk, Skäppträskån, Långtjärn (vid Skellefte älv N om Mörttjärn); naturlig damm i *Cypripedium*-traktens moränområde; Valtjärn, Storbäcken och Mensträsk. *P. perfoliatus* Malåträsk, Skellefte älv. *P. praelongus* Malåträsk, Fårträsk. *P. gramineus* × *lucens* (bestämd av prof. G. Samuelsson) i Storbäcken och Mensträsk. *P. lucens* icke funnen i Sverige så nordligt, men i Finland går den ända upp i Kemi lappmark (Holmbergs Flora). Om den här uppe funnits men dött ut, kan ju dock hybriden leva kvar.

Sagittaria sp. i avan N om Sandfors i Skellefte älv, på 5—7 dm djup, sandlerbotten, steril 1928.

Scheuchzeria palustris t. a. i våta starrkärr och våta mossar. Den kalla sommaren 1928 sågs den blomma ännu $^{27}/_{7}$!

Triglochin palustre sälls.: vid landsvägsbron över Storbäcken (9 km Ö om Kyrkbyn), i kärr nära Malån vid Fårbergsvägen; stranden av Mörttjärn; Valtjärn vid Grundnäs massvis.

Baldingera (Phalaris) *arundinacea* vid Skellefte älv östligast i socknen.

Anthoxanthum odoratum a. på lägdorna. Som den icke kunnat anträffas varken i sydberg eller på stränder, måtte den vara införd.

Hierochloe odorata t. a. på åstränder, eljest sällsynt: vägkant i myr vid Fårträsk; östra ändan av Kyrkbyn i vägkant.

Milium effusum mkt sällsynt: Tjamstan.

Phleum alpinum a. även på kulturjord.

Alopecurus pratensis förvildad på kulturjord; ett par ex. i en bäck vid vinterväg på Fnöskberget. *A. geniculatus* a. på kulturjord; vid kallkälla bredvid nyssnämnda vinterväg. *A. aequalis* t. a.

Agrostis tenuis a. *A. borealis* a. i diken, vid bäckar.

Apera spica venti sälls. i sädesåkrar.

Calamagrostis purpurea a. bland buskar vid sjöar, åar och bäckar. Övre blad kunna vara glest långhåriga ovan. *C. lapponica* t. a. överallt. *C. lanceolata* sälls. på stränder: vid Fårträsk, vid Vormbäcken (slåttermyr), vid nedre Malån på skiffern. *C. neglecta* ganska spridd, ofta tillsammans med *C. lapponica*. *C. epigejos* mkt sällsynt. (Se *Cypripedium*-trakten sid. 73.)

Deschampsia caespitosa a. *D. flexuosa* a.

Phragmites communis a. i myrar, t. a. i sjöar; blommar, dock icke detta kalla året 1929.

Molinia coerulea a. i myrar och på bäck- och åstränder.

Melica nutans t. a. sydberg, grankälar, bäck- och åstränder.

Poa trivialis Kyrkbyn på åtminstone ett par ställen; vid bäck i *Cypripedium*-trakten. Således både på kulturjord och i vildmark. (Troligen t. f. av förväxling med andra *Poa*-arter var den förut antecknad som allmän och uppmärksammades icke vidare förrän sista tiden.) *P. pratensis* a. på kulturjord. *P. angustifolia* a. i skogsmark. *P. alpigena* i kallkällor. *P. alpina* a. på tunen och lägdorna. *P. palustris* sälls. Strömfors, vid Malån, på odlingsjord i byn Ö. Lajnijaur och Kyrkbyn. *P. nemoralis* vid övre Malån, nedre Skäppträskån; Tjamstan; slåttermark vid husen. *P. glauca* i sydberg jämte subsp. *glaucantha*. *P. annua* a.

Festuca rubra ytterst a. både på kulturjord, även i myrodlingar, och i fria naturen. *F. ovina* a.

Nardus stricta sällsynt, införd. Kyrkbyn vid komministergården; Hornberg. Nedom byångarna i Rentjärnberg, Fårberg, Öberg, rikast på sistnämnda ställe, där den går ut från ängsmarkens nedre del och följer skogsvägen nedåt backen ett gott stycke. Tyckes älska fuktighet.

Triticum repens införd, a. på kulturjord. *T. caninum* a. i grankäls-, bäck- och åstrandsvegetation.

Eriophorum polystachium a. *E. latifolium* sälls. I myrar vid Skellefte älv

åt Grytforsen till; i myr söder om den gamla kvarnen vid Fisktjuvträsks utlopp; vid en bäcks inflöde i Valtjärn; bland videbuskar vid stranden i Kyrkbyns östra ände. *E. gracile* rätt utbredd. Melander anför den från Vännäs och Brånnan i socknens västra del; förf. har funnit den vid Fårberg, i våtmyr Ö om Mörttjärn, vid nedre Skäppträskån, i backmyr S om Kvarnberg, mellan Näsberg och Rakkejaur, i myravlopp till Rökån. *E. vaginatum* a. *E. opacum* se *Cypripedium*-trakten sid. 73. *E. Scheuchzeri* t. a. i diken och kärr.

Scirpus lacustris sälls.: Malåträsk vid Kyrkbyn. *S. caespitosus* v. *austriacus* a. *S. acicularis* Malåträsk, Skäppträsk, Skellefte älv, troligen t. a. *S. palustris* **mamillatus* mkt sälls.: den sänkta Valtjärns (vid Lapplandsgränsen) frilagda botten. *S. pauciflorus* lika med föregående. *S. alpinus* a.

Carex dioica a. *C. pauciflora* a. *C. capitata* sälls. I kanten av gångstigen Näsbergsbrännе—Skäppträskån, där den går över en mosse i närheten av ån; vid samma å i landskapsgränsen (J. E. W. !). *C. chordorrhiza* a. i våta starrkärr. *C. festiva* (Macloviana) a. på tunen och lägdorna. *C. stellulata* m. a.: ensam tuva på vinterväg på Granliden i socknens V del (J. E. W.!), vid bäck i byn Bergnäs, i myrar vid Hornberg och S om Svidjan, S om Kvarnberg vid Lapplandsgränsen, i myravloppen till Rökån rikligt. *C. canescens* ytterst allmän. *C. brunnescens* a. *C. loliacea* m. a. vid skogsbäckar t. ex. på Tjamstan, i skogen intill nedre Malån. *C. tenuiflora* m. a. I kärr vid övre Malåns strand nära Friheten, i våtmarken S om östra Fisktjuvträsk, vid bäcken från Kvarnberg till Malån, rätt talrik på Rökåns strandbrädd. *C. digitata* sälls. Tjamstan och på östra skiffern. *C. Goodenowii* och **juncea* mkt a., den senare på stränder. *C. globularis* mkt a. *C. panicea* t. a. *C. vaginata* a. *C. livida* a. i dykärr. *C. magellanica* ytterst a. *C. limosa* t. a. i våta dykärr och våta mossar. *C. polygama* (Buxbaumii) icke sällsynt i myrar och på stränder. *C. Halleri* (alpina) t. a. vid bäckar och i grankälar. *C. flava* a. på åstränder och vid bäckar. *C. Oederi* flerstädes t. ex. vid Skellefte älv, öar i Malåträsk och på torvjord på stranden i Kyrkbyn; Lilla Skäppträsks t. f. av sänkning blottade botten, Valtjärns d:o. *C. pallescens* Malåns strand nederst vid Storforsen. *C. capillaris* a. på åstränder, annars sälls. *C. rostrata* a. *C. vesicaria* a. *C. lasiocarpa* a.

Juncus filiformis a. *J. alpinus* (nodulosus) a. *J. bufonius* införd, a. på fuktiga skogsvägar. *J. stygius* t. a. i våta dykärr. *J. supinus* på bottnen av Malån Ö om Kyrkbyn—Strömfors, steril (bestämd av dr. E. Almquist).

Luzula pilosa a. *L. multiflora* a. *L. sudetica* t. a. på mossar. *L. pallescens* mkt sälls. Trots träget sökande lyckades det först sista året att finna en smula av den, dels ett ex. i kanten av ett f. t. potatisland, 2 km V om Kyrkbyn (bredvid stod ett ex. *Galium uliginosum*, således båda trol. införda); dels ett ex. i en av bäckdalarna i *Cypripedium*-trakten.

Tofieldia palustris a. i myrar och på stränder.

Majanthemum bifolium a.

Convallaria majalis m. a.: den torra Tjamstanbranten, grankälar, stränder.

Paris quadrifolia m. a. grankälar, stränder med lövängsflora.

Orchis incarnata h. o. d. i myrarna enstaka ex., mest på skiffern (J. E. W.). *O. maculata* icke sälls. vid bäckar, i grankälar och på myrar; på Nordbergets sydsida i ljungbacke.

Habenaria viridis sälls. i grankälar och vid bäckar.

Gymnadenia conopsea t. a. i myrar och grankälar.

Epipogium aphyllum sälls. Nedom Tjamstan; det dioritiska Mörtberget (kartans Sappovara) vid Mörttjärn, i en klyftas mot norr vända sluttning (N); 1 km Ö om Rentjärnberg vid Kvarnhedsstigen i granskog på flarkland med friskt, rörligt vatten (J. E. W.!).

Listera cordata a. *Goodyera repens* icke a. men ganska utbredd. Ex. nedom Tjamstan (N.!), Släppliden (J. E. W.), Fnöskberget, Vitstarrberg massvis (N.), Ö om Rentjärnberg med *Epipogium* (J. E. W.), vid Lapplandsgränsen S om Kvarnberg.

Corallorrhiza trifida h. o. d. men få ex.

Malaxis paludosa sälls. I myr S om Malån utmed stigen Rentjärnberg—Näsliden (N.!); i en våt flarkmyr N om N. Malånäs vid vägen till Tjärnberg (N.).

Calypso bulbosa och *Cypripedium calceolus*, se grankälar.

Populus tremula a. som små telningar, m. a. som stort träd.

Salix pentandra: i större delen av området saknas den eller är mkt sälls. I västra delen en l. ett par buskar vid Tullbergsdammen (♂); vid Kyrkbyn fanns en liten buske på stranden till 1924; Strömfors, vid Malån (åtm. förr), en buske vid samma å nedåt Storforsen. Allmännare i östligaste delen, Ö. om Sandfors vid myrängsbäckar, där höga kraftiga ex., fruktificerande även det kalla året 1928. Man får det intrycket, att den har sin västliga utbredningsgräns i Malå. I Sorsele anges den emellertid för Ammarnäs uppe i en fjälldal. Det torde vara en isolerad relikt, motsvarande *Myrica*'s i V. Malå. — *S. caprea* a. *S. cinerea* sälls. En 2 m hög buske (♂) vid Malån, 3 km Ö om Strömfors; ett par buskar i myr nära Bränne (Näsberg), en buske vid Rökån; åtskilliga vid Skellefte älv vid Sandfors — tydligen således hemmahörande i socknens lägsta delar emot Västerbotten. *S. depressa* t. a. på torra backar. *S. myrtilloides* t. a. på myrar. *S. nigricans* utbredd men mycket fåtalig (jfr Samuelsson: »icke sedd i Åsele lappmark»). *S. phylicifolia* a. *S. glauca* a. *S. lapponum* a. (Med hybriderna har förf. föga befattat sig.)

Myrica gale se ovan sid. 79.

Betula verrucosa (hur pass rasren lämnas därhän) t. a. Mer sällan ser man ex. med riktigt grov svart söndersprucken bark nedtill, antagligen på grund av rasblandning med de följande. Prov av glasbjörkar ha av apotekare Gunnarsson ansetts utgöra hybrider, i vilka ingå, utom föregående: *B. pubescens* och **suecica*, *B. concinna* och *B. coriacea*. *B. tortuosa* ingår jämte *B. *suecica*, *B. coriacea* och *B. verrucosa* i de rätt grova björkar, som bilda skogen uppe på det höga Fnöskberget (620 m). *B. nana* a. *B. nana* × *B.* »*pubescens*» h. o. d.

Alnus incana a. vid sjöar, åar, bäckar; stundom i kanten av myrar. Ett ex. av en f. *lobata* vid Malåträsks norra sida, 1 à 2 km V om Kyrkbyn.

Urtica dioica sälls. införd. En liten undangömd förekomst (♂) i Kyrkbyn, tydligen ursprungligen 1 ex.; så ock i Rentjärn. I Rentjärnberg inplan-

terad av en ännu levande person, ♂ o. ♀ (Forke!). Fårberg (♀). Bergnäs by, på minst 3 ställen (röjningsrösen, gammal husgrund), ♂ o. ♀. Brännäs, på sophög ♂ o. ♀.

Rumex domesticus införd, a. vid gårdar och i åkrar. *R. acetosa.* Lika vanlig som på kulturmark och i dennas grannskap, lika sällsynt är den i ursprungliga växtsamhällen (se ovan sid. 83). *R. acetosella* a. som kulturogräs på torr jord och i vägkanter, även vanlig på torra skogsstigar. I Tjamstanbranten, dock icke absolut säker som ursprunglig, då man ser, hur lätt den sprides. Troligen fanns förr mer får och getter än nu.

Polygonum viviparum a. *P. convolvulus* a. i åkrar. *P. aviculare* a. *Chenopodium album* likaså.

Montia fontana kan knappast kallas sällsynt.

Stellaria media införd, a. där människor och husdjur vistas. *S. graminea* a. på gräsmark ss. åkanter och framför allt på lägdor, mycket kulturgynnad. *S. longifolia* endast en liten grupp på torrlagd myrjord utanför Rentjärns skola (bestämd av prof. Samuelsson). *S. calycantha* icke allmän; här och var i skogen, kanske mest i väster (t. ex. Fnöskberget, Holmsjö); Kyrkbyn. *S. crassifolia* på uppkastad myrjord vid stordiket SO om Brännträsk (i socknens östra del (N.!).

Cerastium caespitosum t. a. både i markerna och som kulturogräs.

Sagina procumbens m. a., införd. Rentjärn; landsvägen V om Kyrkbyn; brandplats på Släppliden (J. E. W.); stranden av sjön Brunträsk vid Vännäs, utmed vilken människor och kreatur gå; Brännäs; Håptjärnliden; Fnöskbergets topp (fårtillhåll) i sällskap med *Stellaria media, Rumex acetosella, Poa annua, Ranunculus repens, Cerastium caespitosum* och *Taraxacum* sp.

Spergula arvensis införd, allmännaste åkerogräset.

Viscaria alpina sälls. (Se alpina element sid. 80.)

Silene latifolia (venosa) a. i åkrar; införd.

Melandrium dioicum (rubrum) sälls. (Se grankälar etc.) Även vitblommig.

Nymphaea candida a. *Nuphar luteum* a., även en småbladig form (hybrid?) på olika håll. *N. pumilum* sälls. Skäppträskån nära Rakkejaur. Västerut: i en myrå vid byn Tjäderträsk och i en skogstjärn vid landsvägen strax väster om Malåliden.

Caltha palustris a. *Actaea spicata* sälls. (Se grankälar o. sydberg.)

Ranunculus reptans a. vid stränder. *R. lapponicus* flerstädes i bäckar, t. ex. i Tjamstansvacka, S och Ö om berget; Fårträskbäcken (till Malåträsk) (B.); bäck S om Svartliden (N.!); Hornberg flerstädes (N.); myravlopp till Skäppträskån nära Rakkejaur. Blommorna äro välluktande, ha samma doft som ♂-blommorna hos sälg, vilket förf. icke sett omnämnt i någon handbok. *R. auricomus* sparsam vid Malån o. Malåträsk; på hemäng i Adak. *R. acris* a. på lägdor. I grankälar, vid bäckar och på åstränder. *R. repens* a. *R. peltatus* v. *suecicus* i en del sjöar, Malån, Skellefte älv (stilla vikar).

Thalictrum flavum icke sällsynt vid Malån; Fårbäcken; i Kyrkbyn vid Malåträsk (B.).

Subularia aquatica a. i sjöar, åar; Skellefte älv.

Thlaspi arvense a., införd. *Th. alpestre* åkrar, lägdor flerstädes.
Sinapis arvensis och *Raphanus raphanistrum* införda med säd, förekomma även i kornåkrar, som uppges besådda med insocknes utsäde; vanligen saknas de dock där.
Barbaraea vulgaris t. a., inkommen antagl. med klöverfrö; bibehåller sig i vallarna. *B. stricta* ganska spridd men icke a. Vid älven och åarna; i dygrop nedom Rentjärn, vid en källa i vägkanten 8 km Ö om Kyrkbyn.
Nasturtium palustre sälls. vid kulturmark: vid Malåträsk, även nere vid Strömfors; på myrjord vid Rentjärn och Långträsk; tvättställe vid sjön nedom Svidjan (S. Fårträsk). Införd.
Arabis arenosa visade sig 1928 på åkrar i Kyrkbyn och Fårträsk, vägkanter vid Strömfors; 1929 i Rentjärn, men mer sparsamt på föregående ställen.
Cardamine pratensis här och var vid sjöar ochrinnande vatten men ofta svag, steril, så att den icke bemärkes. Har skaftade småblad och tydligt gredelinådriga kronblad: *C. dentata* kan ej upprätthållas!
Capsella bursa pastoris a. *Erysimum cheiranthoides* sälls., införd. Ex. Kyrkbyn, Brunträsk.
Drosera rotundifolia och *D. longifolia* jämte v. *pusilla* (Kihlman) a. Den förra arten i vitmossa, den senare i dy, båda på blöta stränder.
Saxifraga hirculus sälls.: tvenne myrar i öster nämligen Svanmyran vid Brännträsk och en vid Björklandet (J. E. W.; N. !).
Ribes pubescens mkt sälls.: vid översta Malån; en ensam buske på sydsidan av Brännberget (kartans Granliden) i samma trakt (J. E. W.).
Parnassia palustris a.
Sorbus aucuparia endast f. *glabrata* a.
Rubus idaeus h. o. d. särskilt i sydberg, sydlutor, grankälar, i synnerhet på östra skifferområdet. *R. arcticus* a. vid stränder och på torrlagd torvjord. Blomning nästan hela sommaren men liksom annorstädes dålig fruktsättning. Rikast sådan sedd 1928 på klippholmar i Skellefte älv. *R. saxatilis* t. a. (lövängsvegetation). R. *arcticus* × *saxatilis* på åstränderna. *R. chamaemorus* a.
Fragaria vesca sälls. (Se sydberg, grankälar etc.)
Potentilla palustris a. *P. Crantzii* på torra ställen: i vägkanter och på gårdstunen här och var. Införd? *P. argentea* endast Tjamstan. *P. norvegica* sälls., införd. Då och då på kulturjord, i Kyrkbyn vid olika tillfällen; vid Tullbergsdammen 1928, Brännäs 1929. *P. erecta* a.
Filipendula ulmaria t. a. vid bäckar och stränder, i grankälar.
Alchemilla alpestris sälls.: vid övre Malån. *A. acutidens* kulturjord, införd och *A. subcrenata* likaså.
Rosa cinnamomea t. a. på fasta l. steniga bäck-, å- och sjöstränder; i grankälar.
Prunus padus som föregående.
Trifolium repens införd, a. på kulturmark men sprider sig ut därifrån. *T. pratense* som föregående men sprider sig mindre.
Anthyllis vulneraria endast på Tjamstan.
Vicia cracca a. på lägdor. Införd.

Geranium silvaticum a. i grankälar; vid bäckar och på åstränder; ofta vitblommig.

Oxalis acetosella endast hittad på Fårberget, dels utanför byn i den torra skogsbacken, dels vid en åt öster rinnande bäck på bergets fortsättning åt det hållet. Som de båda jägmästarna aldrig under sina ideliga vandringar sett denna lätt observerade och igenkännliga växt, måste den vara en av de sällsyntaste i socknen.

Callitriche verna och f. *minima* a. [1926 trodde sig förf. i en submers *Callitriche* i Skäppträskån ha funnit *C. hamulata*, på grund av de tydligt »hamulata» bladen och de ensamma frukterna. Prof. Samuelsson lutade ock däråt men tillrådde att ta mer material. I somras gjorde förf. så, och på dem lyckades det att med miskroskop se märken, men de voro *Callitriche verna*'s korta, upprätta. Bladen räcka således icke till för diagnosen. Man gör nog bäst i att t. v. med skepsis upptaga Vesterlunds uppgift om *C. hamulata* i Lule älv i Jokkmokk.]

Rhamnus frangula se ovan sid. 78.

Viola arvensis m. a. (*Viola tricolor* plägar finnas vid Strömfors, sparsamt.) *V. epipsila* a. *V. montana* sydberg, å- och bäckstränder, lövängsartad lund vid sjön i Kyrkbyn. På hemängen på Öberg tillsammans med smultron, troligen ursprungligen planterade. — Vid Stora Skäppträsks utlopp en liten samling rent vitblommiga ex. bland de normala, med långa smala (2 à 3 : 1) bladskivor med tvär bas, så förvillande lika *V. stagnina*, att den, som icke vet härkomsten, sannolikt skulle kalla dem så. *V. Riviniana*: Tjamstan.

Daphne mezereum a. i grankälar, vid bäckar och åar.

Epilobium collinum sydberg. *E. palustre* a. *E. davuricum* på östra skifferområdet vid källor och bäckar. *E. lactiflorum* mångenstädes, t. ex. mitt för Kyrkbyn vid gården Fäbodmark; Håptjärnliden, rikligt på Fnöskberget tillsammans med *E. Hornemanni*, som är t. a. i källdrag, kan ock finnas vid andra bäckar. *E. alsinifolium* se alpina element sid. 80. *E. anagallidifolium* d:o. *E. angustifolium* a.

Myriophyllum alterniflorum icke så sällsynt i sjöar, åar, Skellefte älv.

Hippuris vulgaris m. a. i skogstjärnar, t. a. i sjöar, åar, Skellefte älv.

Carum carvi a. vid gårdarna. *Anthriscus silvestris* som föregående. (Även på Tjamstan; ursprunglig?)

Angelica silvestris a. på stränder, i grankälar.

Peucedanum palustre t. a. på stränder av myrmarksnatur, mest vid skogstjärnar. Satte åtm. 1926 mogen frukt, men knappast 1928, 1929 (blomning börjar $^{17}/_{8}$ 29).

Cornus suecica t. a. vid sjöstränder, myrkanter, bäckar, i skogsmark med rörligt jordvatten; i Adak t. o. m. på södersluttande, numera torr hemäng.

Empetrum nigrum a.

Pyrola chlorantha sälls. på tallmo; Tjamstanuren. *P. rotundifolia* m. a. *P. minor* a. *P. media* sälls.: Malåliden i mossrik tallskog, Tjamstansvacka. *P. secunda* a. *P. uniflora* t. a. i grankälar.

Ledum palustre a. i hela socknen.

Andromeda polifolia a. *Calluna vulgaris* a.

Arctostaphylos uva ursi a. på rullstensgrus och berg.

Vaccinium vitis idaea a. *V. myrtillus* a. *V. uliginosum* a. *V. oxycoccus* a. jämte **microcarpum*.

Lysimachia thyrsiflora t. a. vid sjöarna och åarna; dock icke vidare rikligt blommande.

Trientalis europaea a.

Gentiana amarella **lingulata* sälls., införd. Sedan efter tre års fåfängt letande äntligen 1927 4 små svaga individ hittats i gårdsplatsens kant vid Vännäs skjutsstation, anträffades 1929 på hemängar vid andra gårdar i byn rikligt med stora, delvis buskiga exemplar, förgrenade från basen; de nedersta blommorna ända vid marken torde rädda växtens existens vid slåttern. Hornberg, vid en av de gamla gårdarna (N. !). Toppfrukt, öppnad före $^{10}/_{8}$ 1929 under pågående höbärgning, visar, att växten kan spridas med hö. *G. nivalis*, några rätt kraftiga individ 1928 vid Rentjärn på blomrik gårdsbacke.

Menyanthes trifoliata a.

Myosotis arvensis a. på kulturjord.

Scutellaria galericulata t. a. på sjö- och åstränder.

Prunella vulgaris införd, på hemängar och åkerkanter. Rentjärn, Rentjärnberg, Kyrkbyn, Fårberg, Mörttjärn, Hornberg, Bergnäs, Vännäs.

Galeopsis tetrahit, G. bifida, G. speciosa införda, a.

Veronica serpyllifolia t. a. på kulturjord och i övrigt på av människor beträdda, något fuktiga platser, t. ex. sjöstränder vid båtlänningar, fuktiga skogsstigar, således antagligen införd. *V. scutellata* sälls. vid Malåträsk: båtlänning vid Fårbäckens mynning, Strömfors gamla båtlänning. [Finns vid Skellefte älv i grannsocknen Norsjö och vid Vindeln och Ume älv i Lycksele (Melander).] *V. officinalis* i Tjamstanbranten; Fnöskberget (B.). *V. chamaedrys* införd, sälls. på gräsmark i Kyrkbyn.

Melampyrum pratense a. *M. silvaticum* a.

Euphrasia brevipila a. *E. minima* vid övre Malån vid Tallberg.

Bartsia alpina rätt riklig, där Bockträskån och Malån mötas och ett stycke uppefter dem. Även i en myr där på Malåns södra sida (N.).

Rhinanthus minor a. på lägdor, vid bäckar, på åraningar.

Pedicularis palustris a., ofta vitblommig. *P. sceptrum Carolinum* icke så sällsynt på strandängar och vid myrkanter. I Kyrkbyn österut bland strandbuskar.

Pinguicula vulgaris a. t. ex. vid bäckar. *P. villosa* t. a. i *Sphagnum*-tuvor på mossar.

Utricularia vulgaris t. a. men alltid steril (B.). *U. intermedia* t. a. i våta starrkärr, bäckar, åvikar; blommar rikligt.

Plantago major a.

Galium palustre a. *G. uliginosum*: endast sedd på 4 ställen nämligen en fläck på fuktig äng i byn Bergnäs i fullt naturlig miljö; 1 ex. i åkerkant 2 km V om Kyrkbyn; i vägkanten på myrodlingen vid Fårträsket; Sandfors hemäng i grop, uppkommen vid nedgrävning av telefonstolpes stagkabelsankare. Således införd. *G. triflorum* Tjamstan. *G. trifidum* sälls. Vännäs, rikligt på stranden av sjön Brunträsk; vid utloppet av sjön Sikträsk därsammastädes; vid hölada på torrlagt starrkärr vid vägen till Ytterberg. *G. boreale* sälls. på lägdor (införd). Ursprunglig vid nedre

Skäppträskån och nedre Malån. *G. aparine* sällsynt åkergräs: Hornberg, Bränne, Långträsk.

Linnaea borealis a. *Valeriana sambucifolia* t. a. vid bäckar, åar; sälls. i grankälar. Liksom i Jokkmokk stundom med många (6—8) och smala småbladspar, lik *V. officinalis*.

Campanula rotundifolia se sydberg; a. på lägdorna och i vägkanter. *C. patula* i flera år i Kyrkbyns östra ände på slåtteräng, 1928 i stor mängd.

Lobelia Dortmanna i Malåträsk och Lilla Skäppträsk; blommade även denna kalla sommar.

Solidago virgaurea a.

Erigeron acris sydberg, torra vägkanter och lägdor, t. a. *E. elongatus* sälls. (angavs av Melander 1883 för Malånäs); Tjamstan; Strömfors, på lappvisteängen (J. E. W.!) tillsammans med föregående art; vid en gård i Brännäs; Svartlund, på en torr bit av gårdsängen.

Antennaria dioica a. *Gnaphalium silvaticum* t. a. *G. norvegicum* t. a. *G. supinum* se alpina element sid. 80.

Achillaea millefolium a. på kulturjord och i vägkanter; utmed åar.

Matricaria inodora a. införd. *M. suaveolens* se ovan sid. 85.

Chrysanthemum leucanthemum a. på hemängarna, se ovan sid. 83.

Petasites frigidus sälls. i bäckar t. ex. N, Ö och S om Tjamstan; *Cypripedium*-marken; Bastusel (N.); V om Tallberg (J. E. W.).

Tussilago farfara införd, se ovan sid. 85.

Saussurea alpina a. särskilt vid bäckar och i grankälar.

Carduus crispus a. i åkrar.

Cirsium heterophyllum i grankälar, vid bäckar och åar. *C. palustre* sälls. på våt ängsmark vid bäckar: Malånäs, Springliden, vid Adakån, i källmark i *Cypripedium*-trakten, i strandvegetation vid Vormbäcken (Hornberg).

Hypochaeris maculata nederst vid Malån. (Se sydberg sid. 67.)

Leontodon autumnalis a. på kulturjord, vägkanter, raningar.

Taraxacum. Förf. förstår sig icke på detta släkte och har därför föga blick och intresse för arterna. Enligt dr. Dahlstedts bestämning av förf: obetydliga material tillhöra de vanliga, ursprungliga i trakten *T. croceum* (coll.), växande litet varstädes på bäck- och åstränder, i grankälar och även myrar, blott där är rörligt vatten. Ett ex. *T. remotijugum* Lindb. fil., taget på ett något myllrikare ställe i skogen, hade ock kommit med. — På kulturjord finnas allmänt större, införda arter. De medförda proven voro *T. intricatum* Lindb. fil., *T. macrocentrum* Dt. och *T. cochleatum* Dt. & Lindb. fil.

Sonchus arvensis sälls. införd i åkrar; tyvärr troligen icke tillfällig. Håptjärnliden 1926, Småberg 1928; ovisst om mogen frukt bildas.

Mulgedium alpinum m. a. Tjamstan; vid bäckar på Åmliden (J. E. W.); Viterlidens nordsluttning (N.); Rentjärnbergets nordsida (N.); bäckar till Malån mittför Strömfors; Fnöskberget m. m.

Crepis paludosa a. vid bäckar och i grankälar. *C. tectorum* t. a. på torr odlad jord, införd.

Hieracium. Här gäller detsamma som om *Taraxacum*. Första sommaren gav intryck av att föga fanns att få. Detta intryck har dock icke alldeles

bekräftats de senare åren, om än *Hieracium*-floran må betecknas som jämförelsevis fattig. Enligt framlidne fil. dr. K. Johanssons och fil. dr. H. Dahlstedts granskning av medfört material utgöres en del av obeskrivna nya former. De, som kunnat helt eller något så när bestämmas, följa här under framhållande av att av Archieracierna blott anföras några få namn utan minsta tanke på fullständighet.

Pilosella.

Cauligera humilia. — *H. suecicum* Fr. subsp. *helveolum* Dt. i gräsmattan vid Rökåns strandbrädd, sydligast i socknen.

Collinina. — *H. transbottnicum* Norrl. på kulturjord: Kyrkbyn, Hornberg, Rökåberg (införd?).

Glomeratina. — *H. dubium* L. f. *tenerescens* Norrl. björkbacke med blåbär och ekorrbär vid byn Bergnäs. f. *subfloribundum* Norrl. och f. *vacillans* Norrl. på mot söder sluttande ängsmark vid gårdar i Rentjärn och Rentjärnberg.

Cymosina. — *H. arctogenum* Norrl. i Tjamstanbranten.

Archieracium.

Oreadea. — *H. diasemum* Omang i Tjamstanbranten.

Silvaticiformia. — Hit höra de vanligaste Hieracierna. Så gott som intet har insamlats; alltför talrika för den okunnige, som hade måst medtaga allt! *H. coadunatum* Dt. och *H. stenolepis* Lbg. i Tjamstanbranten.

Caesia. — *H. coniops* Norrl. (umbricola) vid Kyrkbyn i björkbacke mot sjön. *H. subarctoum* Norrl. Malålidens gård.

Vulgata genuina. — *H. minuriens* Dt. på skiffern vid nedre Malån. *H. subpellucidum* Norrl. Brunträsk. *H. subramosum* Lönnr. cfr **kuusamoense* Wainio Brunträsk.

Rigida. — *H. rigidum* (coll.) — närmast *sparsifolium* Lbg. på Malåns raning västerut vid Friheten. *H. lapponicum* Fr. Mörttjärns by och flerstädes. *H. aureum* Dt. torr ängsmark vid Sandfors. *H. rectum* Dt. Strömfors äng. *H. dolabratum* Norrl. vid övre Malån; torr hemslätta vid Bränne; Hornbergs by (f. *pleonis*). *H. coronopus* Dt. Malån vid Storforsen. *H. cruentiferum* Norrl. & Lindb. fil. Strömfors lappviste-äng med björkgrupper.

Foliosa. — *H. polycomum* Dt. torr mark i Kyrkbyn, torr ängsbacke i Kuorbevare, strandbrink i Ö. Lajnijaur, vägkant i Adak; Vännäs, Bergnäs, Högnäs. *H. angustum* Lbg. på åstränderna t. ex. Malån, Skäppträskån, Rökån men även i Rentjärnbergs sydbacke. *H. umbellatum* L. i flertalet byar men få och svaga ex. utan umbella. Ex. Brännäs, Kyrkbyn, Brunnäs, Strömfors, Högnäs; även på öar i Malåträsk och vid Storforsen i Malån. *H. chloromelanum* Dt. Strömfors lappviste; vid Rökån.

Summa minst 325 arter (utom sl. *Taraxacum* och *Hieracium*), som man kan säga alla år finnas inom området. Av dessa torde 52 = 16 % vara genom människan införda.

* * *

De botaniskt intressantaste områdena äro, såsom framhållits, den edafiskt betingade Tjamstans sydsida, grankälarna, bäck- och åstränderna. Fnöskberget är rätt intressant. Det är källrikt, klätt av betuletum och abiegnum myrtillosum med mycket grankälsvegetation, rik på ormbunkar, björntolta (*Mulgedium*) och duntrav-(*Epilobium*)-arterna. I hjässans björkar ingår fjällbjörk; i sydkanten märkes branten Habak (se sydberg sid. 66). På dess norra sluttning ligger byn Bergnäs med *Carex stellulata, Galium uliginosum, Mulgedium alpinum* och *Hieracium dubium* f. *tenerescens.* (Förf. misstänker, att där är mera att finna.)

Mer geografiskt grundad är den något större rikedomen närmast Västerbotten: *Scirpus mamillatus* och *pauciflorus* vid Valtjärn, *Baldingera* vid Skellefte älv, *Carex pallescens, Salix cinera* och *pentandra* (jfr artlistan), *Galium boreale* och *Hypochaeris* vid åar och älvar; *Pteris* och *Calamagrostis epigejos* i *Cypripedium*-trakten — de härda icke ut längre upp på det magra underlaget. Någon edafisk faktor måste medverka till *Cypripedium*-traktens rikedom. Av särväxterna där: *Carex capitata, C. digitata, Cypripedium, Cystopteris montana, Melandrium dioicum, Equisetum *scirpoides, Eriophorum opacum, Calamagrostis epigejos* och *Epilobium davuricum* trivs ju flertalet förträffligt i fjällens björkregion. Även av de andra träffar man på de lösa skiffrarna uppe i Tärna (vid riksgränsen) på nytt — men då som västliga invandrare — *Baldingera, Carex pallescens, Galinm boreale* och därtill andra, som i öster gjort halt redan före Malå, såsom *Geum rivale* och *Viola palustris.* Någon klimatmildring genom havets närhet där uppe kan det ej bero på, då flera av dem uppträda på Dovre med dess kontinentala läge. *Cypripedium* är en kalkväxt, *Equisetum *scirpoides* måtte vara detsamma: se deras utbredningskartor för Uppland hos Almquist. (N. Upplands morän och ishavslera äro starkt kalkhaltiga till följd av silurkalkstenslagren på sjöbottnen Ö om Gävle); på Storön i Nederkalix med stor kalkhalt i jorden, växa dessa båda också (Svenonius). Enligt Andersson & Birger är även *Carex capitata* kalkväxt. Berggrunden under *Cypripedium*-trakten i Malå består, att döma av de massvis därpå liggande blocken, av kvartsskiffer utan karbonatreaktion. Av den sedan flera år här i samband med malmförekomsterna verksamme geologen fil. dr. Ove Bäckström har emellertid meddelats revirföreståndaren, att de porfyrer, som bilda berggrunden mellan Tjamstans porfyrit och skiffrarna i öster, äro omvandlade, inkrusterade med kalciumkarbonat och därför

fräsande för syror. Lerskiffern (öster om kvartsskiffern) däremot är kalkfattig men grafithaltig. Som isriktningen var sydostlig i Norrland, bör moränen i *Cypripedium*-trakten härstamma från nämnda kalkhaltiga porfyr. Det torde alltså vara förklaringen till områdets särskilda flora.

Östra nedre delen av Malå är alltså rikast. Endast i den västra förekomma *Bartsia, Euphrasia minima, Epilobium anagallidifolium, Lycopodium alpinum, Ribes pubescens* (och *Myrica*!). Att *Ribes* saknas vid åarna längre ned skulle kunna tänkas bero på att folk eventuellt tillägnat sig den för plantering (såsom enligt Simmons faktiskt varit fallet i Kiruna).

* * *

Om man kring Malå kyrkby begränsar ett område, drygt 2 km långt, så att det innesluter både Tjamstanfårorna på sydsidan och ett stycke av sjön Malåträsk, 1 km V om kyrkan, och 2 km vinkelrätt däremot, således ca $4\frac{2}{3}$ kvkm $= \frac{1}{375}$ av socknen, så finner man inom detta 244 kärlväxter = 75 % av hela områdets! Denna relativa rikedom är icke ett tomt sken, beroende på förf:s övervägande vistelse just där, utan den har en naturlig förklaring i den samlade förekomsten av de olika edafiderna och Tjamstans rikedom: sydberget med bäckar, grankälstrakt därnedom, myr och skogstjärnar N om berget, kulturmarken i kyrkbyn och den visserligen något magra strandvegetationen men i stället jämförelsevis rika vattenfloran. Det är ett exempel på vad som i inledningen sades, att vegetationen i stort sett är densamma överallt inom området.

Jämförelser.

Sockenjämförelser.

När man vill jämföra ett områdes i östra Lappland flora med det västras, får man lov att ha i minne, att fjällområdet i det senare har en så betydligt rikare flora, vilket Sernander så träffande karakteriserat i sin förklaring till att östra Lappland förblivit så botaniskt okänt: detta med sin fattigdom har betraktats av de resande botanisterna närmast som ett hinder, vilket man sökt att så fort som möjligt komma igenom för att nå fjälltrakternas härligheter. Detta är ju för alla begripligt. Men vad som icke ännu torde vara för den stora allmänheten bekant (och icke heller var

det för förf. före sysslandet med Malåfloran), det är, att västra Lappland icke blott har sin fjällflora utan tillika en hel del låglandsväxter, som det östra saknar (såsom i föregående avdelning redan vidrörts). Många icke-fjällväxter ha längs den blidare norska kusten vandrat längre norrut än vid Bottenhavet och därifrån genom dalgångarna gått upp mot riksgränsen in i fjällområdets dalar även på svenska sidan; vi ha i Lappland således dels östliga, dels västliga invandrare. [Det är att beklaga, att det arbete, där detta med kartor så klart visas: Den norrländska florans geografiska fördelning och invandringshistoria av Gunnar Andersson och Selim Birger, till följd av sitt omfång och därmed följande pris är för amatörbotanister otillgängligt.] Vill man göra en rättvis jämförelse mellan Malås och Sorseles floror, bör därför hänsyn tagas endast till barrskogsområdet i den senare socknen, och västliga invandrare frånskiljas. Sorselelistan anges icke vara fullständig, men vid jämförelse med vad man här får veta om Malå och förut vet om Lapplands växtvärld f. ö., förefaller det icke att kunna vara så mycket, som brister i den i avseende på skogsregionen. (Ett fullständigande av redogörelsen av samma författare lär snart vara att motse.)

För grannen i söder, Lycksele, finnas Melanders spridda uppgifter liksom för Norsjö i öster. Om den norra grannen, Arvidsjaur, vet man ännu just intet, däremot finns Vesterlunds fullständiga lista för Jokkmokk, norr om A. För att icke göra denna jämförelse för lång — Jokkmokk har många, både i Malå och de andra socknarna felande såväl fjäll- som låglandsväxter — medtagas därifrån endast sådana, som tillika finnas i Sorsele eller Lycksele.

Växter,

kända från skogsregionen i grannsocknarna (med Jokkmokk i st. f. det okända Arvidsjaur), men felande eller hittills icke funna i Malå.

(Jo betecknar förekomst i Jokkmokk, Ly i Lycksele, No i Norsjö, So i Sorsele.)

	So	Ly	Jo	No	Anmärkningar
Struthiopteris germanica		+	+	+	+ Arjeplog Grapeng. 1917
Alisma plantago-aquatica	+	+	+	+	
Poa remota				+	
Elymus arenarius	+	+	+		
Carex aquatilis	+		+		

	So	Ly	Jo	No	Anmärkningar
Carex gracilis	+		+		
» *heleonastes*			+	+	+ Jörn (N om Norsjö)
» *laevirostris*		+	+		
» *ericetorum*				+	
» *tenella*			+	+	
» *diandra*			+	+	
Rhynchospora alba		+			(Holmbergs flora)
Scirpus silvaticus			+	+	
Salix lanata	+		+		
Polygonum amphibium	+		+		
Sagina Linnaei	+				
» *nodosa*	+		+	+	
Trollius europaeus	+	+	+		
Aconitum septentrionale	+				+ Skellefte landsförs.
Myriophyllum spicatum				+	
» *verticillatum*	+				Allmän i Vindeln
Angelica archangelica	+	+	+		
Cicuta virosa	+	+	+		Icke a. i södra Lappl. (Melander)
Viola palustris			+		
» *umbrosa*		+	+		
» *biflora*	+		+		
» *mirabilis*		+			
Sedum acre				+	
» *annuum*	+				+ Jörn
Astragalus alpinus	+		+	+	
Asperugo procumbens			+	+	
Myosotis caespitosa	+		+		
Mentha arvensis		+		+	
Utricularia minor		+	+		
Viburnum opulus		+		+	

En del luckor bero på saknaden av fullständig förteckning från Lycksele och Norsjö.

Geum rivale (»a.» i Sorsele) utelämnas här. Vesterlund säger om den: Kvikkjokks kyrkplats (i fjällbygden således, förf:s anm.), ej iakttagen längre ned; Melander: flerstädes i Vilhelmina fjällbygd. Andersson & Birger: *Geum* är icke känd från mellersta skogsområdets sydberg. — Den är således en av de norska invandrarna.

— Om *Viola palustris* säger Vesterlund: a. i fjällen, mycket sällsynt i skogsområdet. Samuelsson omtalar den emellertid från Siksjö i Åsele, 6 mil från Västerbottensgränsen. *Viola mirabilis* har en enda reliktförekomst i Lycksele och en i Lövånger N om Skellefteå, saknas f. ö. här i öster. Ungefär likadant är det med *Viburnum opulus*, så att det är helt naturligt, att de fattas i Malå.

En och annan av ovanstående listas växter finnes troligen ändå i Malå. Vid den nedersta milen av Skellefte älv, som icke besökts av förf. (till följd av avståndet och saknaden av vägförbindelse med socknen i övrigt), och som skall vara lika steril som stranden högre upp, kan dock möjligen finnas t. ex. *Alisma, Sagina nodosa* och *Mentha*. Så föga framträdande växter som *Carex tenella* och *Viola palustris* (bland *V. epipsila*) kunna gott ha undgått uppmärksamheten. *Carex heleonastes* kan finnas i de många myrarna i öster, som icke besetts. Emellertid måste det anses som anmärkningsvärt, att i Malå verkligen saknas *Polygonum amphibium*, *Trollius europaeus, Aconitum septentrionale*, *Tussilago* (ursprunglig) samt sannolikt också *Alisma*, *Carex gracilis* och *C. aquatilis*, den senare förgäves särskilt eftersökt år efter år.

Pressad *Polygonum amphibium* har uppvisats för folk i olika delar av socknen, men aldrig har någon kunnat säga sig ha sett sådan.

Tvärtom saknas i Sorselelistan av Malå-växterna (de flesta troligen till följd av förbiseende) *Equisetum pratense*, *E. variegatum*, *E. *scirpoides*, *Poa trivialis, Carex pauciflora, C. livida, Eriophorum latifolium, E. gracile, E. opacum, Stellaria crassifolia* och *Pyrola media*. *Scirpus acicularis*, som saknas i listan, har sedan meddelats i Holmberg: Skandinaviens flora. *Woodsia ilvensis* finns, se Bihanget.

Verkligen felande i Sorsele torde vara följande, som då ha sin västgräns i Malå, nämligen *Sparganium minimum, Sagittaria, Calamagrostis epigejos*, *Poa palustris, Carex pallescens* (såsom östlig), *Juncus supinus, Malaxis paludosa, Salix cinerea*, *Nasturtium palustre*, *Pyrola chlorantha*, *Lobelia Dortmanna* och *Hypochaeris maculata*. (Om *Salix pentandra* se artlistan).

Om man till de 412 Sorsele-arterna lägger de troligen förbisedda 10 men frändrager de tillfälliga, de västliga invandrarna och de fjällväxter, som saknas i Malå, och från de 325 Malå-växterna de, som där ha sin västgräns, skulle återstå ungefär 319 Sorsele-arter att jämföra med 311 i Malå. (Motsvarande tal för Jokkmokk blir

ungefär 361.) För Lycksele och Norsjö saknas fullständig förteckning.

Det ser således ut, som om grannsocknarna vore något rikare än Malå. I fråga om Västerbottenssocknen Norsjö är det ju helt naturligt. Beträffande Lycksele kring Vindel- och Umeälvarna bör observeras, att utmed Vindeln ha vandrat upp *Carex laevirostris, Elymus arenarius, Mentha arvensis* och *Myriophyllum verticillatum* och långt ned *Trollius* och *Archangelica* (Melander), men dessa följa icke Skellefteälven. Dennas stränder äro karga, steniga och grusiga, mest obebodda, under det att Vindelns har finare avlagringar med odling, rent av hela byalag.

Sydbergsjämförelser.

I Andersson & Birgers anförda avhandling, ett riktigt sydbergsverk, omtalas rikligen, liksom ock under årens lopp i Sv. Bot. Tidskrift, V. Lapplands, fjällområdets, sydberg. Dessa äro icke jämförbara med mellersta och östra Lapplands, emedan de, utom fjällväxter, hysa åtskilliga av de från Norge invandrade låglandsväxterna, som icke gå ned i skogsområdet i mellersta Lappland. Från detta senare ha A. & B. sydberg (efter Melanders uppgifter) endast för sydligaste delen, till Ume älv. Den Gaunitzka Sorseleredogörelsen har endast sydberg i fjällområdet. Sydbergen i Malås andra lapska grannsocknar — Lycksele och Arvidsjaur — vänta ännu på sina skildrare.

De närmaste kända att jämföra Malås med bli då: Kyrkberget i Stensele (A. & B.); Storåberget i Norsjö, känt av Melander, skildrat som sydberg av Sörlin; Malåberget i Sorsele, se bihanget till denna uppsats, Rackberget vid Älvsbyn i Norrbotten, undersökt av Hesselman, publicerat av C. G. Alm; de sydlappländska i Åsele och Fredrika (A. & B.) och Solberget i Ångermanland, 1 mil S om Lappland (Samuelsson). Se tabellen!

Utom vad som däri anföres har Kyrkberget 5 västligt invandrade arter, som icke finnas i Malå, och en del andra mer allmänna växter i västra Lappland såsom *Aconitum, Melandrium dioicum, Oxalis* m. m. Av Malås sydbergsväxter saknas på detta annars så rika berg *Convallaria majalis, Galium triflorum, Habenaria viridis, Viola montana* och *Riviniana*.

Detta stora berg vid den väldiga sjön Storumans norra strand ligger endast 10′ nordligare men 8 resp. 10 mil västligare än

Sydbergsväxter	Tjamstan, Malå	Malåbgt, Sorsele, Lpl.	Solbgt, Ångermanl.	Fredrika, SÖ. Lpl.	Hembgt, Åsele, S. Lpl.	Rackbgt, Norrbotten	Storåbgt, Norsjö, Vb.	Kyrkbgt, Stensele, Lpl.
Actaea spicata	+		+	+				+
Anthriscus silvestris	+							+
Anthyllis vulneraria	+							+
Astragalus alpinus							+	+
Botrychium lunaria	+							+
Campanula rotundifolia	+							+
Carex digitata	+	+	+	+	+	+	+	+
Cerastium alpinum		+					+	
Circaea alpina				+				
Convallaria majalis	+		+	+				
Cystopteris fragilis	+	+				+	+	+
Draba rupestris						+		+
Epilobium collinum l. *montanum*	+	+	+	+	+	+		+
Erigeron elongatus	+	+						+
Fragaria vesca	+		+	+		+	+	+
Galium triflorum	+		+	+				
Melica nutans	+	+				+	+	+
Paris quadrifolia	+							+
Poa glauca l. *glaucantha*	+	+						+
» *nemoralis*	+	+				+		
Polypodium vulgare	+	+	+	+	+	+	+	+
Potentilla argentea	+							+
Pyrola chlorantha	+			+	+			
» *media*	+		+	+				
Saxifraga groenlandica							+	
Sedum acre							+	
» *annuum*		+						+
Silene rupestris				+				
Triticum caninum	+			+				+
Turritis glabra						+		+
Veronica officinalis	+			+				+
Viola montana	+						+	
» *Riviniana*	+		+					
Viscaria alpina	+	+	+			+	+	+
Woodsia ilvensis	+	+	+			+	+	[1]

[1] *W. alpina* i stället.

Malås sydberg, alldeles intill fjällområdet, därför har det en del av dettas växtrikedom med även västliga låglandsväxter. F. ö. stämmer det, som synes, väl överens med Tjamstan.

Storåberget

vid Skellefte älv, 4 ½ mil nedom Lapplandsgränsen, är högst märkligt genom sina fjällväxter, vilka, utom *Cerastium alpinum* och *Viscaria alpina,* saknas i alla här anförda sydberg; därtill kommer kustområdets *Sedum acre.*

Fredrika

betecknar en sammanfattning av 3 sydberg där.

Rackberget

ligger 4 mil Ö om Lappland, 12 ½ mil NO till O från Malå kyrkplats, 30′ nordligare, 5 mil från kusten (Malås centrum 11 á 12 mil).

God överensstämmelse med Malås visa således jämte Kyrkberget, dels sydbergen i östra Åsele och Fredrika (= S. och SÖ. Lapplands), dels Solberget strax söder därom och slutligen Rackberget i NO, som dock har två i Malå felande växter: *Draba rupestris* och *Turritis.* Fredrikas på samma sätt två, nämligen *Silene rupestris* och *Circaea alpina.* För dem är Malå för nordligt, *Silene* upphör i öster redan före Umeå, *Circaea* vid Skellefteå. — Alla utom Kyrkberget äro de — såvida uppgifterna om dem äro fullständiga — fattigare än Tjamstan.

Sammanfattning.

Ehuru fullständiga växtförteckningar för grannsocknarna saknas, torde man redan kunna med visshet påstå, att Malåfloran är något fattigare än deras. Såsom ett par sannolika orsaker därtill kan anges dels områdets mindre utsträckning, dels Skellefteälvens stränders magerhet, görande den i motsats mot Vindeln olämplig till vandringsstråk för växter.

Sydberget Tjamstan är däremot, för att tillhöra inre urbergsområdet, ett rikt sydberg.

Det märkligaste i Malåfloran är f. ö. närvaron av *Epilobium anagallidifolium* och *Lycopodium alpinum* 5 mil från det sammanhängande fjällområdet, *Myrica* 14 mil från kusten; *Cypripedium*; i sydberg *Viola Riviniana* och *Potentilla argentea;* frånvaron

av *Alisma* och *Butomus* (sannolikt), *Carex aquatilis*, *Polygonum amphibium*, *Astragalus alpinus*, *Myosotis caespitosa;* i sydberg *Turritis* samt sällsyntheten av *Scirpus palustris* (endast **mamillatus*), *Luzula pallescens* och *Stellaria longifolia;* alla blott funna på en lokal (hittills).

* * *

Östra Lapplands växtvärld är fattig icke blott genom artantalets ringhet utan lika mycket genom individantalets, när det gäller andra av kulturen oberoende växter än barrskogens och myrarnas konstituenter. Det framgår icke av en artlista, man måste se det i naturen för att fullt fatta det. Huru många kilometer, att icke säga mil, måste man t. ex. ofta gå för att träffa en större ormbunke eller en hallonbuske! *Fragaria vesca*, *Galium boreale*, *Prunella vulgaris* väcka uppseende. *Oxalis acetosella* på ett helt litet område på en 17 kvmils yta! Kommer man hit ned från de vattenförande fjällskiffrarnas yppiga björklider med deras både fjällväxter och västligt invandrade låglandsväxter, av vilka åtskilliga felas i mellersta och östra Lappland, somliga även i kustlandet vid Bottenhavet här norrut, och uppträdande där i fjälltrakten med en helt annan frodighet, då bör denna magra torftighet bli särskilt slående; östkustens flora däremot går ju helt omärkligt över i det inre urbergsområdets.

Men hur mycket enformigare och dystrare tedde sig icke vegetationen före åkerbrukets införande! Nästan intet annat än de dystra myrarna och de sorgflorbehängda (*Alectoria*-arter) skogarna! Det är som ett trolleri, när denna magra skogsmark och dessa dvärgbjörksrismyrar under människans händer förvandlas till slåtteräng och åker. Av myrarna blir det dels åker, dels tuvtåteläng med smörblommor och ängssyra, i alla händelser ett saftgrönt och gulskimrande inslag i landskapet. Men vid gårdarna, på moränbackarna mot söder, vilken färgrikedom i högsommartid! De prunka av kattfot, rölleka, prästkragar, gråbinka, gullris, hök- och höstfibblor, liten blåklocka, höskallra, röd- och vitklöver, kråkvicker, kummin, smörblommor, ormrot, bergs- och ängssyra, — frånsett gräsen. Vägkanterna hysa ock denna vegetation fast mindre lysande till följd av betningen. Den färgglada kroppen (*Epilobium angustifolium*) får genom människans röjningar tillfälle att breda ut sig på den frilagda marken, i rishögar och stenrösen och lyser upp i landskapet. Ligger intill odlingsmarken björk-

backe, sprider sig gärna dit något av lägdans rödklöver och kråkvicker, som tillsammans med dess ursprungliga kovall, gullris och hökfibbla etc. ger en antydan till löväng, vilket man här eljes ju blott finner längs en del bäckar och på de smala åraningarna. Endast sällan vidgas dessa t. ex. genom någon ö längs stranden eller halvö, och man kan där få höra trädgårdssångarens sydländskt klingande toner.

Är floran i Malå än fattig, så må det dock erkännas, att författaren av denna skildring ingenstädes sett så mycket tibast som i dess grankälar och längs dess vattendrag eller sådana drivor av vita näckrosor som i dess åar eller så mycket jämna (*Lycopodium complanatum*) som i dess torra tallskogar eller så mycket parasollmossa (*Splachnum luteum; S. rubrum* däremot sällsynt) som på dess myrar och i skogarna. Och icke ens i fråga om växtvärldens aristrokater, orkidéerna, ha ju dessa trakter blivit lottlösa (11 arter), ja, man finner där både själva skogsfrublomman och i första sommartiden, och det i stor mängd och på många ställen, en sådan utsökthet som den väna nornan, en av den svenska florans allra finaste gestalter.

Om de icke oävna naturscenerierna och den intressanta, rikt växlande berggrunden är här icke platsen att orda; vare det nog sagt, att ett område även i östra Lappland, om det icke tages till för snävt, hur fattigt och tröstlöst det än vid första ögonkastet ter sig, dock kan ha något att bjuda på för forskaren, t. o. m. för botanisten. Skaparen har i Sveriges land omgivit oss med en rik och härlig natur!

Bihang.

Om Malåberget,

ett sydberg i Sorsele s:n, 1 ½ km från Malå sockengräns.

På detta, tämligen fritt liggande och vida om synliga, överst delvis skoglösa berg med upptill branta sidor, om vars växtlighet Sorsele-redogörelsen i denna tiskrift årg. 1924 intet nämner, fäste förf. 1928 jägm. G. Nylanders uppmärksamhet. (Namnet av Malån, som rinner förbi dess fot.) Han besökte det i slutet av augusti och meddelade i brev (med tillåtelse till publicering), att han där träffat de i Malå s:n icke funna växterna *Arctostaphylos alpina*, *Cerastium alpinum* och *Sedum annuum*, således intressanta fynd.

Berget intar motsvarande läge i landskapet mot Arasjöfjällen (Sernander), men dess höjd över havet är endast 588,4 m, d. v. s. det når icke upp till den naturliga barrskogsgränsen (sannolikt nära 100 m högre upp), och dock träffas där tvenne fjällväxter, som icke förekomma på det 31 m högre Fnöskberget i Malå, 19 km SSO därom! Det berget är emellertid en helt skogbevuxen kupol, som icke erbjuder på sin övre del de fria ljusöppna ståndorter, som fjällväxter äro vana vid, och kan alldeles avbrännas vid skogseld, så att inga »relikter» bli kvar. — På Arasjöfjällen, verkliga fjäll, 9 mil sydligare, fann Sernander utom ett par fjälllavar inga andra fjällväxter än *Arctostaphylos alpina* och *Juncus trifidus*.

Den 23 sistlidne juli besökte förf. själv Malåberget och kunde endast bestyrka fynden. Bergarten är dels blå, dels röd porfyrit. Nordsidan, tämligen brant, klädes av abiegnum myrtillosum med *Cornus suecica*. Denna vegetation tränger in i de skåror, som uppdela bergets överdel i tre partier, liggande i NV—SO. Den östligaste är kal, den mellersta, större, har även ovanpå en del små vindpinade tallar och granar, den västligaste är helt skogklädd. Det var de två första, som förf. besökte. Deras sydsidor stupa lodrätt ned, den östras östsida är också bar, lodrät. På branterna små exemplar björk, asp, rönn; på sydsidan, nere vid foten av översta branten, större träd, bl. a. grövre sälgar. Prov av topparnas björkar ha av apotekare Gunnarsson bestämts som 1) *B. coriacea* × *tortuosa* × *verrucosa*, 2) *B. pubescens* **suecica* × *tortuosa* × *verrucosa*, 3) *B. coriacea* × *pubescens* **suecica* × *tortuosa*. De kala delarnas lågvegetation karakteriserades av *Arctostaphylos uva ursi, Festuca ovina, Cerastium alpinum* v. *lanatum* och *Viscaria alpina*. Dessa stå även på småskrevorna i sydbranten jämte *Epilobium angustifolium* och några Archieracier av olika grupper. I springor *Cystopteris fragilis, Woodsia ilvensis* och *Polypodium vulgare*. (*Cystopteris* mest nedtill, där träden ge skugga.)

Bergets topplatåer bjuda på en härlig, vid utsikt och besökas åtskilligt av människor (eller djur?), därom vittnar den nötta stigen på toppen med *Poa annua*. På mitten av mellantoppen med utsikten fri ned i Malådalen rent av en liten »kulturplats» med en saftig, mörkgrön matta av *Rumex acetosella, Agrostis tenuis, Poa annua* och *Cerastium caespitosum*. Den sista flerstädes på platåns sydkant; *Stellaria graminea* torde nog vara ditkommen på samma sätt; möjligen ock några *Euphrasia minima* i *Festuca ovina-*

mattan. I det tunna jordlagret små, 2 dm höga *Calamagrostis lapponica*, i branten större ex. *Sedum annuum* i ett rikt bestånd på östra toppens platå; *Arctostaphylos alpina* däremot endast i ett enda, större exemplar på en särskild topplatå.

Nedom översta sydbranten blockmark. Här växa fortfarande *Cerastium alpinum* och *Viscaria*, men därtill komma *Epilobium collinum* (typisk), *Erigeron acris* (sälls.), *Melica nutans* (d:o), *Poa* cfr *glaucantha*, *P. nemoralis* (typisk), *Rubus idaeus*, *R. saxatilis*, *Sedum annuum* (rikl.) och *Viola montana*.

Härnedanför ny brant och sedan skarpt sluttande barrskogsmark ned till Malån. Denna nedre brant hindrade utbrytande regn förf. att bese. Troligen var det där, som jägm. Nylander funnit *Erigeron elongatus* tämligen rikligt.

Sedum annuum är en vanlig sydbergsväxt i västra Lappland (se t. ex. Grapengiesser 1917, Frödin, Birger); den anges för tre andra sydberg i Sorsele, inom fjällområdet, av vilka det närmaste torde vara minst 45 km från Malåberget. Att träffa den här, avgjort inom skogsområdet, precis mitt emellan riksgränsen och Bottenhavet är nog så märkligt. Denna lokal bildar en föreningslänk mellan det norsk-svenska utbredningsområdet i väster och den enda kända förekomsten i öster, 74 km härifrån, meddelad i Backman & Holms flora, Hemberget i Jörns socken, vid Byske älv, $1\frac{1}{2}$ km utanför Lapplandsgränsen, växtens enda kända förekomst i landskapet Västerbotten. Enligt Andersson & Birger slutar *Sedum annuum*'s utbredning från söder uppefter Norrlandskusten strax söder om Örnsköldsvik. Huruvida den till dessa sydberg i centrum och öster gjort språng västerifrån eller är en kvarleva från en sammanhängande nordligare svensk utbredning under den postglaciala värmetiden, är ju svårt att säga, i synnerhet så länge eventuella sydberg i Arvidsjaurs Lapplandssocken V om Jörn, äro outforskade; nog förefaller det senare alternativet sannolikast.

Enköping i oktober 1929.

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A METHOD FOR GROWING PLANTS UNDER STERILE CONDITIONS.

BY

ALFRED ÅSLANDER.

Many methods for the growing of higher plants under sterile conditions have been recommended. The method here described was worked out in order to be able to add nutrients to plants which were growing for rather long time under sterile conditions. At the same time it was found necessary to change somewhat the hypochlorite seed sterilization method.

The apparatus used is seen in Fig. 1.; the essential parts consist of an Erlenmeyer flask (1) and a Berkefeld filter (8). Around the neck of the flask a glass cylinder (3) was fitted. Its lower end was tightly attached to the flask by means of electricians' tape (2) (insulation band). Around the glass tubing (6) a cotton plug was wound which fitted the neck of the flask. Above the cotton plug a wide mouthed funnel (4) was placed around the glass tubing and held in position by a piece of a thick rubber tubing (5). In the upper end of the glass tubing a one hole rubber stopper (7) was fitted and in it the Berkefeld filter (8). The filter with the rubber stopper could be removed so that the seeds could be planted in the flask through the glass tubing.

The seeds were sterilized over night in a 2,5 per cent solution of sodium hypochlorite. Ten cc of the American antiseptic Z o n i t e containing ten per cent of sodium hypochlorite was mixed with thirty cc of water. Since only one or two seeds in a hundred germinated and only one plant could be grown in each flask it was necessary to germinate the seeds before they were planted in the growing flasks. After sterilization they were transferred from the antiseptic solution to small flasks containing sterile water and kept in these until some seeds just began to germinate. The

fact that no washing of the seeds is necessary when this antiseptic is used is one of its chief advantages. When small sprouts were formed the seeds were transferred to the sterilized growing flasks, one to each of them. As the growth medium in the flasks fine sand moistened with a nutrient solution was used.

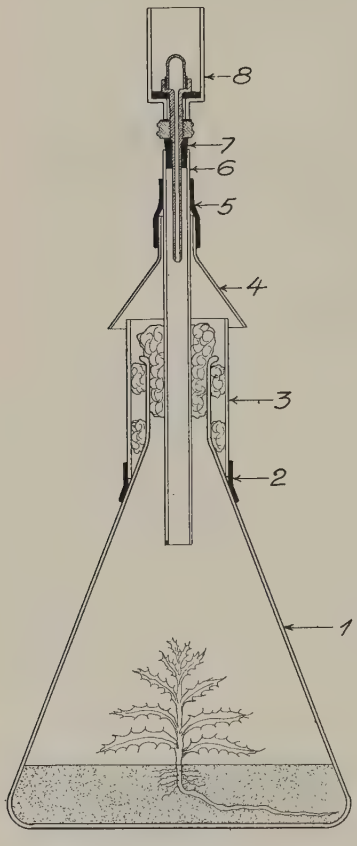

Fig. 1. Apparatus for growing plants under sterile conditions.

It was found that the plants, *Cirsium arvense*, thrived best when a rather diluted nutrient solution was used. New solutions were added at suitable intervals. First a rubber stopper with a fifty cm high glass tubing was fitted in the glass cylinder which surrounds the filter cone. On top of this tubing a funnel was attached and the nutrient solution added. The hydraulic pressure was sufficient to force the solution through the filter cone. The funnel (4) protected the cotton plug from being wetted by the solution if any was spilt.

The glass cylinder (3) served not only to help the cotton plug support the filter, it also facilitated the introduction of carbon dioxide into the flasks. A stream of the gas was lead beneath the funnel (4) for some minutes at suitable intervals. That some of the gas penetrated through the cotton plug into the flasks was evident because the plants receiving this treatment grew better than those to which no gas was given.

The method also may be used for water cultures. If the sand in the flasks is replaced by small glass beads the plants will have sufficient support for the roots to grow erect. If a siphon is inserted through the cotton plug the nutrient solution may be completely drained off and renewed.

The results of the investigation in which this method is being used are not ready for publication. This note may serve to introduce the method to other workers.

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EINE NEUE CALDESIA-ART.

VON

GUNNAR SAMUELSSON.

Die Gattung *Caldesia* wurde im Jahre 1854 von Parlatore aufgestellt, und zwar auf Grundlage des schon im Jahre 1768 beschriebenen *Alisma parnassifolium* Bassi. Allgemeine Anerkennung gewann die neue Gattung wohl nicht, aber der letzte Monograph der Familie, F. Buchenau, hat stets für ihre Berechtigung plädiert. Buchenau rechnet zu *Caldesia* auch *Alisma acanthocarpum* F. Muell. und *A. oligococcum* F. Muell., beides seltene und in den Herbarien immer noch äusserst spärlich vertretene Pflanzen. Dieses ist an einzelnen Stellen in Australien, Südasien und Westafrika gefunden, jenes auf Australien beschränkt. Einzelne Autoren führen wohl auch das aus Indien beschriebene *Alisma reniforme* D. Don als selbständige Art auf. Meiner Ansicht nach ist es nur als grosswüchsige tropische Rasse (Var. *major* Micheli) von *Caldesia parnassifolia* zu betrachten. Eine vierte Art beschrieb indessen Ostenfeld im Jahre 1914 (Philippine Journ. Science, Bot., IX, p. 259) als *C. sagittarioides* Ostf. aus Indochina. Diese habe ich aus Kopenhagen leihweise bekommen und kann bestätigen, dass eine ausgezeichnete Art vorliegt. Ich bin jetzt im stande, noch eine fünfte hinzuzufügen, und zwar handelt es sich um eine Pflanze, die seit langem in den meisten grösseren Herbarien vorhanden ist.

Caldesia parnassifolia ist eine amphibische Pflanze mit je nach den wechselnden äusseren Verhältnissen ziemlich verschiedenem Aussehen. Die europäische Pflanze ist verhältnismässig kleinwüchsig. Die Höhe des Stengels hält sich zumeist zwischen 25 und 50 cm. Die Blattspreite ist etwa 2—3 cm lang, 1,5—2 cm

breit (vgl. Fig. 1 *d* und *e*). Die Zahl der Staubblätter beträgt, wie es scheint, stets 6, Früchtchen meist 8—10. Die aussereuropäischen Pflanzen, d. h. aus Afrika, Australien und den wärmeren Teilen von Asien bis nach Japan, stimmen im wesentlichen mit dem europäischen Typus überein. Nur sind sie in allen Teilen grösser: die Blätter nach indischen Exemplaren 5—9 cm lang, 3,5—6 cm breit (vgl. Fig. 1 *c*). Eine Angabe, dass bisweilen 9 Staubblätter vorhanden sein können, bezieht sich wahrscheinlich auf die unten als neu aufgestellte Art. Auf eine Nummer aus Zentral-Afrika (Bahr-el-Gasal-Gebiet, Schweinfurth Ser. III n. 222) hat Buchenau eine Var. *nilotica* gegründet, und zwar wegen des spongiösen Mesocarpiums der Früchtchen. Eine darin vollständig übereinstimmende Form sah ich aus Australien, Rockingham Bay (F. Mueller: Hb. Kew.). Der systematische Wert dieser Form dürfte somit nicht besonders gross sein.

Für *Caldesia parnassifolia* var. *major* habe ich einige Fundorte kennen gelernt, welche die bekannte Verbreitung wesentlich erweitern. Folgende dürften erwähnenswert sein. Celebes: Lura-See, 650 m (Sarasin n. 1240: Hb. Berol.). Zentral-Afrika: Kilimandjaro und Meru, im Balbal-See, 1200 m (Uhlig n. 512: Hb. Berol.); Kamindas am Bangweolo-See (R. E. Fries n. 1007: Hb. Upsal.); Angola (Welwitsch n. 3015: Hb. Kew.).

In den Beschreibungen von *Caldesia parnassifolia* findet man bisweilen Angaben über Merkmale, die gewissermassen ausserhalb des Rahmens der für diese Art gültigen liegen, z. B. dass die Blattspreite bis 17 cm breit, ihre Basis kaum herzförmig sein, und dass die Zahl der Staubblätter bis auf 9 steigen kann. Meine Nachprüfung hat indessen gezeigt, dass sich diese Merkmale auf eine übersehene, ganz verschiedene Art beziehen. Bei den vorliegenden Exemplaren wechselt freilich die Form der Blattspreite ziemlich erheblich. Ihre Basis wird aber nie so ausgesprochen herzförmig wie bei der echten *C. parnassifolia*. Die Blätter mit etwas ausgerandeter Basis (Fig. 1 *b*) scheinen schwimmend gewesen zu sein, während die wahren Luftblätter fast gerade Basis besitzen und ausgesprochen breiter als lang sind (Fig. 1 *a*). Noch grösser sind die Unterschiede in den Blüten. Die untersuchten haben durchgehends 11 Staubblätter und 12—20 Früchtchen, d. h. in beiden Fällen etwa die doppelte Anzahl gegenüber *C. parnassifolia*. Bezüglich des Baues der Früchtchen bin ich nicht ganz sicher. Bei einem Exemplar (leg. Lobb) war die Fruchtwand wie bei der

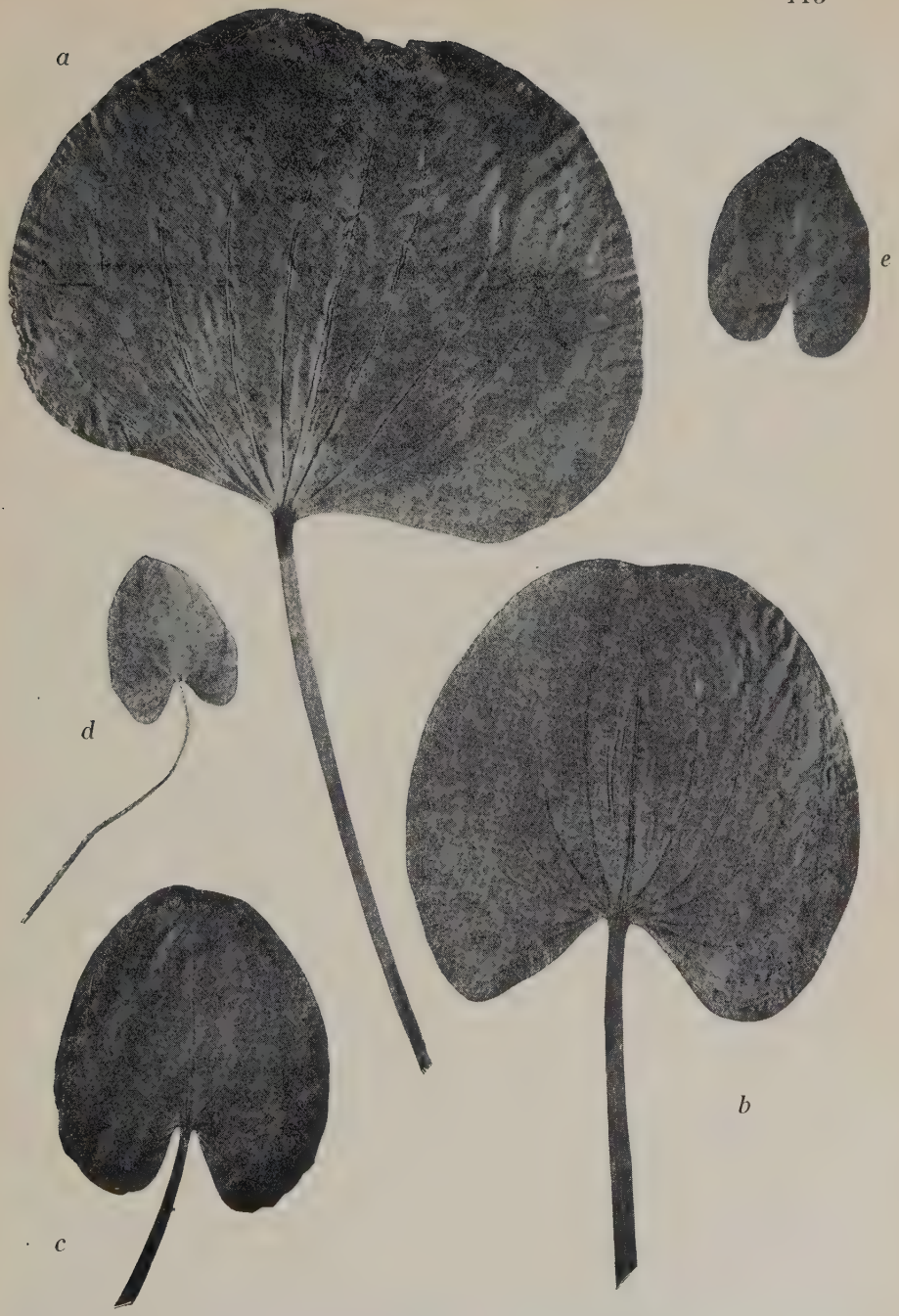


Fig. 1. *a, b. Caldesia grandis* (aus Khasia). *c. C. parnassifolia* var. *major* (aus Celebes). *d, e. C. parnassifolia* (*d* aus Süd-Russland, *e* aus Ungarn). — $^3/_5$ nat. Gr.

Hauptform von *C. parnassifolia*, bei in einem Konvolut auf einem Bogen aus Khasia Hills (leg. Hooker et Thomson: Hb. Berol.) loseliegenden Früchtchen dagegen wie bei Var. *nilotica* gebaut. Sämtliche Exemplare, die mir vor die Augen gekommen sind, sind mehr als 60 Jahre alt. Es sind folgende, alle aus Indien. Khasia: 4—5000′ bei Joowye, Nonkreem, Nunklow und Nurtiung (1850 Hooker u. Thomson: Hb. Berol., Haun., Holm., Kew.); East Bengal: Khahol (Griffith in Kew Distrib. n. 1204: Hb. Kew.); ohne nähere Lokalangabe (Lobb: Hb. Kew.).

Folgende Diagnose gibt in erster Linie die Unterschiede gegenüber *C. parnassifolia* an.

Caldesia grandis Sam. n. sp.

Planta valida. Caules floriferi bene evoluti 100—150 cm alti erecti. Folia petiolo 30—60 cm longo, natantia lamina cordato-orbiculari 9—9,5 cm lata, emersa lamina orbiculari—suborbiculari 6—12 cm longa 7—17 cm lata basi truncata apice interdum subemarginata. Inflorescentia magna verticillatim racemosa, interdum nonnisi hibernaculis praedita, florifera interdum etiam hibernacula solitaria floribus intermixta gerens. Stamina (vulgo) 11; pistilla 12—20; stylus 2 mm longus.

Hab. in prov. Assam et Bengalia Indiae orientalis.

Svensk Botanisk Tidskrift. 1930. Bd. 24, H. 1.

DIE KONIFERENGATTUNG LIBOCEDRUS ENDL. IN OSTASIEN.

VON

RUDOLF FLORIN.

Mit 2 Tafeln und 2 Textfiguren.

Im Jahre 1873 beschrieb Kurz (in Journ. Bot., XI, 1873, p. 196) aus dem westlichsten Yünnan (bei Hohta nahe an der burmanischen Grenze) eine neue Konifere, die er *Calocedrus macrolepis* n. gen. et sp. nannte. Die Gattung wurde später von Bentham (in Bentham & Hooker, Gen. plant., III, 1880, p. 426) eingezogen und die Art zu *Libocedrus* übergeführt, da die Samen, auf deren von Kurz vermutetem abweichendem Aussehen die Gattung *Calocedrus* begründet wurde, bei einer Nachuntersuchung vollkommene Übereinstimmung mit denen von *Libocedrus* zeigten.

Die ursprüngliche, nicht ganz befriedigende Beschreibung dieser *Libocedrus macrolepis* (Kurz) Benth. durch Kurz hat, wie wir im folgenden sehen werden, dazu geführt, dass alle *Libocedrus*-Bäume in Yünnan mit angrenzenden Gebieten und auf Formosa, von wo man später die Gattung nachgewiesen hat, mit Unrecht zu einer und derselben Art gerechnet worden sind.

Während meiner Untersuchungen über die systematische Bedeutung innerhalb der Koniferen von denjenigen Merkmalen, die von der äusseren Morphologie der Blätter und sonstigen Assimilationsorgane sowie vor allem von ihrer Epidermisstruktur geliefert werden, wurde ich auf eine Angabe von Pilger (in Engler & Prantl, Natürl. Pflanzenfam., 2. Aufl., XIII, 1926, p. 389) aufmerksam, nach der die Zweiglein von *Libocedrus macrolepis*, die an ihrem Ende ♀ und ♂ Zapfen tragen, rundlich (also nicht abgeflacht wie die sterilen

Zweige) sind und kleinere, kürzere, gedrängt imbrikate Schuppenblätter tragen. Dies besagt somit, dass die dorsiventrale Ausbildung der Seitensprosse bei den fertilen Zweiglein aufgegeben wird und in eine radiäre übergeht. Es interessierte mich, diese Art näher zu untersuchen, und es wurde auf meine diesbezügliche Bitte von den botanischen Museen in Berlin-Dahlem und Kew in zuvorkommendster Weise das in ihnen aufbewahrte Material zu meiner Verfügung gestellt. Ich benutze diese Gelegenheit, um Herrn Direktor Dr. A. W. Hill, Kew, und Herrn Professor Dr. R. Pilger, Berlin-Dahlem, für ihr freundliches Entgegenkommen meinen verbindlichsten Dank zu sagen.

Da weder die Beschreibung noch die Abbildungen von Kurz irgend welche Andeutungen des von Pilger erwähnten eigentümlichen und allen anderen *Libocedrus*-Arten fremden morphologischen Verhaltens der fertilen Zweiglein enthielten, glaubte ich von vornherein das Vorhandensein von zwei chinesischen Arten vermuten zu können. Diese Annahme zeigte sich aber nicht richtig. Das reichliche und sehr schöne Material aus Yünnan, das ich zu untersuchen Gelegenheit gehabt habe, zeigt durchgehends das folgende Verhalten.

Die sterilen Sprosse letzter und vorletzter Ordnung sind abgeflacht, dorsiventral ausgebildet und besitzen eine dimorphe Beblätterung: Marginal- und Fazialblätter (siehe Textfig. 1 sowie Taf. I, Fig. 1 und 2). Erstere sind bilateral stark abgeflacht, gegenständig, imbrikat oder durch sehr kleine Zwischenräume voneinander getrennt. Sie sind ferner kahnförmig, in Profilstellung gesehen etwa lanzettlich, fast gerade, vom Rücken aus gesehen schmallinealisch, an der abwärts gewendeten Längshälfte gewöhnlich schwächer oder kräftiger ausgehöhlt, an der dem Lichte zugekehrten Längshälfte gerundet, oberseits ausgehöhlt, spitz bis fast stechend zugespitzt, zum grösseren Teil der Achse aufgewachsen, einnervig, im freien Teil aufrecht-abstehend bis angedrückt, an der Spitze schwach einwärts gekrümmt, am Rande des freien Teils trockenhäutig, im ganzen 1—5 mm lang, im freien Teil 0,2—0,5 mm lang, 0,5—1 mm hoch, und ca. 0,5 mm breit. Die Fazialblätter sind an den Sprossen der letzten Ordnungen bis zum Grunde zwischen den Marginalblättern sichtbar und in ungleichartige Ober- und Unterblätter differenziert. Sie sind ferner gegenständig, berühren sich mit den Spitzen, sind bifazial abgeflacht, im apikalen Teil etwa dreieckig, spitz, fast der ganzen Länge nach der Achse aufge-

wachsen, einnervig, angedrückt, oberseits abgeflacht oder schwach ausgehöhlt und am Rande des freien Teils trockenhäutig. Sie zeigen die gleiche Länge wie die Marginalblätter, sind aber im freien Teil kürzer als diese. Die Oberblätter sind unterseits schwach gerundet, die Unterblätter dagegen schwach ausgehöhlt (im getrockneten Zustande). Die Breite der Fazialblätter beträgt 1—1,5 mm.

An den jüngeren Hauptsprossen ist nur ein schwacher Gegensatz oder gar keiner zwischen Marginal- und Fazialblättern zu beobachten. Diese unterscheiden sich ferner von den Blättern jüngerer Sprosse durch ihre grössere Breite und durch die Länge des am Zweig herablaufenden Polsters.

Endständig an dorsiventral ausgebildeten Zweiglein oder in der Achsel eines Marginalblattes kann nun je ein 7—18 mm langes, radiär gebautes fertiles Zweiglein mit homomorpher Beblätterung entwickelt werden, das terminal einen ♀ Zapfen trägt. Die Symmetrieänderung tritt plötzlich ein. Schon wenn der Zapfen sehr jung ist, wie z. B. in Fig. 3, Taf. I, hat das ihn tragende, radiär gebaute Zweiglein eine nicht unbeträchtliche Länge erreicht. Die Blätter sind schuppenförmig, invers-dorsiventral, breit rhombisch-eiförmig oder fast rundlich, an der schwach eingebogenen Spitze sehr kurz gespitzt, unterseits konvex und im apikalen Teil schwach gekielt, oberseits ausgehöhlt, einnervig und an den Rändern des freien Teils trockenhäutig. Sie stehen dekussiert, sitzen der Achse breit auf, sind ihr angedrückt und laufen nur eine kurze Strecke an ihr herab. Ihre Länge beträgt 1—1,5 mm, ihre Breite 1 mm.

So schöne Fälle von Symmetrieänderung der Sprosse letzter Ordnung im Zusammenhang mit der Ausbildung der Zapfen sind innerhalb der Koniferen selten. Ein anderes Beispiel ist *Acmopyle Pancheri* (Brongn. et Gris) Pilg. (Pilger in Engler, Das Pflanzenreich, IV: 5, 1903, p. 117; Sahni in Phil. Trans. R. Soc. London, Ser. B, Vol. 210, 1920, p. 253). Bei dieser Konifere aber tragen die sterilen Sprosse homomorphe, spiralig angeordnete, stark bilateral abgeflachte und fast zweireihig ausgebreitete Nadelblätter und die je einen terminal gestellten ♀ Zapfen tragenden Zweiglein homomorphe, spiralig gestellte Schuppenblätter.

Die je einen terminal gestellten ♂ Zapfen tragenden Zweiglein (Taf. I, Fig. 2) zeigen ein etwas abweichendes Verhalten. Die Aufhebung der Dorsiventralität des Sprosses ist hier niemals vollständig. Es tritt eine mehr oder weniger plötzliche Verkürzung der Blätter und eine Entwicklung der Fazialblätter auf Kosten

der Marginalblätter ein. Aber die ♂ Zweiglein bleiben immer etwas abgeflacht, obwohl weit schwächer als die sterilen. Bisweilen findet fast keine Veränderung der Beblätterung der ♂ Zweiglein statt gegenüber der der sterilen, sondern typische, stark bilateral abgeflachte Marginalblätter werden dicht unter dem ♂ Zapfen gefunden. Bei dem in Fig. 2, Taf. I, abgebildeten Zweig ist fast kein Gegensatz in der Beblätterung zwischen den fertilen und den sterilen Zweiglein vorhanden. Die Beblätterungsverhältnisse und folglich die Ausbildung des Zweigleins sind demnach hier instabil im Gegensats zum Verhalten der ♀ Zweiglein, wo eine vollständige Symmetrieänderung regelmässig eintritt.

Endlich können ausnahmsweise einzelne kurze sterile Zweiglein letzter Ordnung eine ganz ähnliche vollständige Symmetrieänderung aufweisen.

Unter den mir von den Museen in Berlin und Kew geschickten Herbarexemplaren, die als zu *Libocedrus macrolepis* gehörig bestimmt waren und in der floristischen Literatur so bezeichnet worden sind (Hayata, Fl. Mont. Formos., 1908, p. 207; Wilson in Journ. Arnold Arboret., VII, 1926, p. 62), waren einige auf Formosa gesammelt. Sie zeigten sich in gewissen Hinsichten von den chinesischen Exemplaren durchgehends verschieden. Die sterilen Sprosse der letzten und vorletzten Ordnungen zeigen eine derjenigen der Yünnan-Exemplare sehr ähnliche Beblätterung. Sie sind also dorsiventral ausgebildet und tragen Marginal- und Fazialblätter. Sie unterscheiden sich aber von den Yünnan-Exemplaren darin, dass sie graziler sind und oft kürzere Blätter tragen. Auch die Marginalblätter haben einen äusserst kurzen freien Teil, der kaum bemerkbar ist. Die Blätter zeigen folgende Grössenverhältnisse. Die Marginalblätter sind im ganzen 1—5 mm lang, 0,5—0,8 mm hoch und ca. 0,4 mm breit; die Fazialblätter erreichen meist dieselbe Länge wie die Marginalblätter und sind 0,8—1,5 mm breit. Wie bei den soeben beschriebenen Zweigen aus Yünnan treten vereinzelt kurze, radiär gebaute Zweiglein auf, die dann im Gegensatz zu den dorsiventralen bogenförmig abwärts gekrümmt sind. Auch ihre Blätter sind den entsprechenden Schuppenblättern bei den Yünnan-Exemplaren ähnlich und messen 1 mm in der Länge und 1 mm in der Breite.

Bemerkenswert ist nun aber vor allem die Tatsache, dass die je einen terminal gestellten ♀ Zapfen tragenden, nur 1,2—4 mm langen Zweiglein niemals, so viel ich gesehen habe, auch nur eine Andeutung einer Symmetrieänderung zeigen, sondern stets in ganz ähn-

licher Weise, wie normal die sterilen Zweiglein, dorsiventral ausgebildet sind und folglich Marginal- und Fazialblätter tragen (Taf. II, Fig. 1). Junge Stadien sind zum Vergleich mit der Yünnan-Form in Fig. 3, Taf. II, abgebildet worden. Es ist durchaus kein Zufall. Ich habe etwa 25 solche ♀ Zweiglein gesehen, die alle dasselbe Aussehen zeigten. Diese Zweiglein sind ausserdem hier durchschnittlich kürzer als bei der Yünnan-Form.

Dasselbe Verhalten wie die ♀ Zweiglein zeigen auch die wenigen ♂ Zweiglein, die zu meiner Verfügung gestanden haben (Fig. 2, Taf. II).

Offenbar bestehen also in der Ausbildung der fertilen Zweiglein bemerkenswerte Unterschiede zwischen den *Libocedrus*-Bäumen von Yünnan und denen von Formosa. Dass diese Differenzen sich kaum durch die Annahme einer entsprechenden beträchtlichen Variabilität in der Ausbildung der Sprosse sich erklären lassen, geht besonders daraus hervor, dass alle Yünnan-Exemplare ohne Ausnahme durchgehends radiäre ♀ Zweiglein, alle Formosa-Exemplare dagegen durchgehends dorsiventrale ♀ Zweiglein aufzuweisen haben.

In diesem Zusammenhang komme ich auf die Beschreibung und Abbildung der *Libocedrus macrolepis* in der obenerwähnten Arbeit von Kurz zurück. In der Diagnose findet sich keine Angabe über das Aussehen der fertilen Zweiglein. Kurz hat Abbildungen beigegeben (Taf. 133, III, Fig. 1—5), die aber leider nicht einwandfrei sind. Dass die Samen unrichtig gezeichnet worden sind, wurde schon oben angedeutet. Die Zeichnungen der sterilen Zweiglein vom dorsiventralen Bau zeigen wegen der verhältnismässig langen, scharfen Spitze der Blätter, dass es sich um diejenige Form handelt, die ich oben als Yünnan-Form bezeichnet habe. Dagegen scheinen aber im ersten Augenblicke die die ♀ Zweiglein darstellenden Zeichnungen (Fig. 1 und 3) zu sprechen, da die Yünnan-Form stets längere solche Zweiglein zeigt. Ob der Bau der Zweiglein radiär oder dorsiventral ist, ist aus den Abbildungen nicht sicher zu entnehmen. Durch das freundliche Entgegenkommen des Direktors der Royal Botanic Gardens, Kew, habe ich das im dortigen Herbarium aufbewahrte Originalexemplar untersuchen können. Es zeigte sich dabei, dass dasselbe in der Ausbildung der sterilen Sprosse vollkommen mit dem übrigen Yünnan-Material übereinstimmt, so dass kein Zweifel über die Zugehörigkeit aller Yünnan-Exemplare zu einer und derselben Art mehr bestehen kann. Der einzige dem Originalexemplar zugehörige ♀ Zapfen war abgefallen,

und es war nicht möglich zu entscheiden, wo am Zweig er gesessen hatte. Das Zweiglein war offenbar abgebrochen, aber ein 3 mm langes Stück haftete noch an. Dieses Stück zeigte den für die ♀ Zweiglein der Yünnan-Form charakteristischen radiären Bau. Die Abbildungen von Kurz sind wohl demnach kaum in anderer Weise zu erklären, als dass ihm nur

Fig. 1. *Libocedrus macrolepis* (Kurz) Benth.: Spross mit dorsiventral ausgebildeten sterilen und radiären ♀ Zweiglein; am Ende der letzteren je ein fast reifer Zapfen (A. Henry n. 11566 A, Herb. Mus. Berol.). — $^1/_1$.

abgebrochene ♀ Zweiglein vorgelegen haben, die ohne weiteres als auf sterilen Sprossen von dorsiventralem Bau sitzend dargestellt wurden. Damit hat die scheinbare Ähnlichkeit zwischen den Abbildungen von Kurz und den bei der Formosa-Form herrschenden Verhältnissen, die mir zunächst aufgefallen ist, ihre Erklärung gefunden.

Es lag somit die Vermutung nahe, dass die Gattung *Libocedrus* heutzutage statt mit einer mit zwei Arten in Ostasien vertreten wäre.

Die Richtigkeit dieser Annahme wurde während der weitergeführten Untersuchung bestätigt. Es zeigte sich, dass die Yünnan-Form grössere sowohl weibliche (12—20 mm in der Länge und 4—8 mm im Durchmesser gegen 11—16 mm bezw. 4—5,5 mm) als auch männliche Zapfen (Länge: 5—7 mm gegen 4—5 mm) besitzt, ihre Mikrosporophylle grösser sind (vergl. Fig. 2, Taf. I, mit Fig. 2, Taf. II), dass sie gewöhnlich 4 (3—5) Mikrosporangien an jedem Mikrosporophyll trägt (Fig. 4, Taf. I), anstatt 3 (2—3) bei der Formosa-Form (vergl. Hayata, loc. cit. und meiner Fig. 6, Taf. II), und dass die Samen (5—6,5 mm in der Länge und 2,5—3 mm im Durchmesser gegen 4,5—5 mm bezw. 1,8—2,2 mm) und die Samenflügel grösser sind (grösserer Flügel: 13—15 mm in der Länge und 3,5—5,5 mm in der Breite gegen 10—11 mm bezw. 2,5—3 mm) (vergl. Fig. 4 mit Fig. 5, Taf. II).

Wir haben es somit mit zwei verschiedenen Arten zu tun, die beide wegen der kräftigen Ausbildung der oberen sterilen Schuppenwirtel im weiblichen Zapfen zur Untergattung *Heyderia* (K. Koch) Pilger zu rechnen sind.

Libocedrus macrolepis (Kurz) Benth. in Bentham & Hooker, Gen. plant., III, 426 (1880).

Masters in Journ. Linn. Soc., XVIII, 485 (1881) et in Forbes & Hemsley, Ind. Fl. Sin., II, 540 (1899); in Gard. Chron., ser. 3, XXX, 467 (1901). — Henry in Garden, LXII, 183, fig. (1902). — Mayr, Fremdl. Wald- u. Parkb., 316 (1906). — Wilson in Gard. Chron., ser. 3, XLIV, 148 (1908). — Beissner, Handb. Nadelholzk., ed. 2, 493 (1909); Henry & Thomas in Gard. Chron., ser. 3, XLIX, 67, fig. 34 (1911). — Rehder in Bailey, Cult. Evergreens, 221 (1923). — Dallimore & Jackson, Handb. Conif., 305 (1923). — Pilger in Engler & Prantl, Natürl. Pflanzenfam., ed. 2, XIII, 389 (1926). — Saxton in Ann. Bot., XLIV, 168 (1930). — *Calocedrus macrolepis* Kurz in Journ. Bot., XI, 196, t. 133, fig. III (1873). — *Thuja macrolepis* Voss in Mitt. Deutsch. Dendr. Ges., XVI, 88 (1907). — *Libocedrus macrolepis* E. H. Wilson in Journ. Arnold Arboret., VII, 62 (1926) ex parte.

Arbor monoica, usque 30 m alta, pyramidalis. Rami subteretes, patuli vel patentes. Ramuli distichi, alterni, ancipites. Folia decussata: ramorum fere homomorpha, alte adnata seu decurrentia, parte libera brevi, patula vel fere adpressa, ovato-triangulari, pungente; ramulorum dimorpha (facialia et marginalia), quadrifariam imbricata vel marginalia paullulum distantia, facialia adpressa, parte libera late triangulari, serrulata, scarioso-marginata, acuta vel acuminato-pungente, parte decurrente cuneata (in ramulis ultimis facialia et marginalia aequaliter decurrentia), dorsalia subtus convexula, media basi partis liberae vulgo sulco parum distincto

munita, ventralia subtus concaviuscula et medio usque ad basin late et obtuse carinata, marginalia valde complanata, navicularia, dorso alte et anguste carinata, a latere visa lanceolata vel ovato-lanceolata, supra convexa, subtus concava, apice incurva et acuminata, longe decurrentia, parte libera patula usque adpressa, margine serrulata. Strobili masculi in ramulis rectis vel paullulum curvatis, ancipitibus vel subteretibus terminales, subtetragoni, oblongi vel ovoidei, obtusi; microsporophylla 14—20, decussata, subpeltiformia, suborbicularia, umbonata, sporangiis 3—5, vulgo 4. Strobili feminei subcylindrici, in ramulis terminales teretibus, squamis vestitis bifacialibus, ovato-rhomboideis vel fere orbicularibus, mucronatis, late adnatis, dorso convexis et in parte libera indistincte carinatis, supra concavis, scarioso-marginatis; squamae 6, decussatae: infimae steriles (rarissime fertiles), bifaciales, breves, fertilibus, triplo, quadruplo, etiam plus breviores, triangulari-ovatae, ovales vel oblongae, apice recurvatae et obtusae (raro fertiles et tum longiores, intermediis similes); intermediae 2 fertiles (rarissime steriles), oblongo-lanceolatae, dorso convexae, supra concavae, obtusae, aculeo dorsali perparvo, acuto, patentissimo munitae. Squamae summae 2 steriles, complanatae, eodem modo aculeo dorsali munitae; axis in columellam producta centralem, acutam, cum squamis summis alte connatam. Ovula 2, basalia, erecta. Semina ovato-lanceolata, bialata, ala majore ovali vel oblonga, minore lineari-oblonga, basin versus angustissima, tantummodo apice libera, caeterum cum majore connata.

China: Prov. Yünnan, Hohta, ca. 16 km östlich von Mancoyne an der burmanischen Grenze mit reifem ♀ Zapfen, 19.VII. 1868, ges. J. Anderson; Szemao, in 1400 m Meereshöhe, Bäume 6—15 m hoch, mit jungen und reifen ♀ und jüngeren ♂ Zapfen, angepflanzt, ges. A. Henry (n. 11566 A); dieselbe Lokalität, Baum 15 m hoch, mit jungen ♀ und reifen ♂ Zapfen, angepflanzt, ges. A. Henry (n. 11566 B); dieselbe Lokalität, Baum 6—9 m hoch, mit reifen ♀ und jüngeren und älteren ♂ Zapfen, angepflanzt, ges. E. H. Wilson (n. 1759); dieselbe Lokalität, mit reifen ♀ und unreifen ♂ Zapfen, angepflanzt, 1.X. 1899, ges. E. H. Wilson (n. 76); Talang, in 1500 m Meereshöhe, Baum 9 m hoch, mit jungen ♀ und reifen ♂ Zapfen, wildwachsend, ges. A. Henry (n. 11566); Yünnan-fu, mit reifen ♀ Zapfen, angepflanzt, III. 1918, ges. Père Bailly; dieselbe Lokalität, mit älteren ♀ Zapfen, angepflanzt, ges. Ducloux.

Burma: Ober-Burma, südöstlicher Teil, Kengtung (=Kiangtung) an der Yünnan-Grenze, mit jungen ♀ Zapfen, ges. R. S. Hole.

Nach Henry (loc. cit. 1902, p. 183) ist dieser Baum, der eine Höhe von 30 m erreicht und eine schöne Pyramidenform annimmt,

an vielen Stellen im südlichen Yünnan angepflanzt, wurde aber auch im wildwachsenden Zustande von ihm gesammelt, nämlich in Schluchten nahe an den Flüssen bei Talang. Stämme von dieser *Libocedrus*-Art werden oft von den Eingeborenen in den an Flussufer grenzenden Wäldern ausgegraben, wo sie vor Jahren durch Fluten begraben wurden. Dieses Holz wird bei den

Fig. 2. *Libocedrus formosana* Florin n. sp.: Spross mit dorsiventral ausgebildeten sterilen, sowohl als auch fertilen, je einen ♀ Zapfen tragenden Zweiglein (E. H. Wilson n. 10960, Herb. Kew). — $^1/_1$.

Chinesen zur Verfertigung von Särgen besonders feiner Qualität benutzt.

Henry erwähnt weiter, dass die *Libocedrus*-Bäume (gleich wie *Cupressus* und *Thuja*) vor 2000 Jahren um die Grabhügel angepflanzt wurden, wo die Feudalprinzen beerdigt waren. Diese Bäume wurden deshalb gewählt, weil sie stattliche langlebige wintergrüne Pflanzen sind und aus diesem Grunde den Glauben an die Unsterblichkeit versinnbildlichten.

Die Art liefert ein sehr wertvolles Bauholz.

Libocedrus macrolepis wurde im Jahre 1899 nach England eingeführt. Mr. E. H. Wilson schickte Samen von Szemao an die bekannten Messrs. James Veitch & Son, denen es im Frühling 1900 gelang, Keimpflanzen aufzuziehen. Im Kew Herbarium liegt eine photographische Abbildung einer älteren Keimpflanze. Die Seitenzweiglein sind alle mit dimorpher Beblätterung ausgestattet, die sich von der des Folgestadiums nur darin zu unterscheiden scheint, dass die Blätter (»die Internodien») im allgemeinen eine grössere Länge zeigen und länger, mehr stechend zugespitzt sind. Dies zeigt auch die Abbildung von Mayr (loc. cit., p. 316).

Nach Dallimore & Jackson (loc. cit., p. 306) ist die Art kaum als in England winterhart anzusehen. So weit mir bekannt ist, ist sie noch nicht in anderen Ländern eingeführt worden.

Libocedrus formosana n. sp.

?*Libocedrus* sp. Matsumura in Tokyo Bot. Mag., XV, 137 (1901). — *Libocedrus macrolepis* Hayata in Fl. Mont. Formos., 207 (1908) (non Benth.). — *Libocedrus macrolepis* Kanehira, Anat. Charact. Ident. Formos. Woods, 237 (1921) (non Benth.). — *Libocedrus macrolepis* E. H. Wilson in Journ. Arnold Arboret., VII, 62 (1926) ex parte.

Arbor monoica, usque 23 m alta. Rami subteretes, patuli vel patentes. Ramuli distichi, alterni, ancipites. Folia decussata: ramorum fere homomorpha, alte adnata seu decurrentia, parte libera brevi, adpressa vel patula, late triangulari, acuta vel obtusiuscula; ramulorum dimorpha (facialia et marginalia), quadrifarium imbricata vel marginalia paullulum distantia, facialia adpressa, parte libera late triangulari, serrulata, scarioso-marginata, acuta aut obtusa, parte decurrente cuneata (in ramulis ultimis facialia et marginalia aequaliter decurrentia), dorsalia supra convexula, medio vulgo inde a basi usque ad apicem sulco parum conspicuo praeditae, ventralia subtus concaviuscula, medio obtuse carinata, marginalia valde complanata, navicularia, dorso alte et anguste carinata, a latere visa lanceolata, supra convexula, subtus concava, apice paullulum incurva, acuta vel obtusiuscula, majore pro parte adnata et decurrentia, parte libera patula usque adpressa, margine serrulata. Strobili masculi in ramulis brevibus, subrectis, ancipitibus terminales, subcylindrici, obtusi; microsporophylla 16—18, decussata, subpeltiformia, suborbicularia, umbonata, sporangiis 3, raro 2. Strobili feminei subcylindrici, in ramulis rectis terminales; squamae decussatae: infimae 2 steriles, bifaciales, breves,

recurvae, triangulari-ovatae, obtusae; intermediae 2, fertiles, bifaciales, oblongae, obtusae, dorso convexae, supra planae, aculeo dorsali perparvo, acuto patentissimo munitae; squamae summae 2 steriles, complanatae, eodem modo ac fertiles aculeo dorsali munitae; axis in columellam apice bifidam, cum squamis summis connatam producta. Ovula 2, basalia, erecta. Semina oblonga, bialata, ala majore oblonga, minore lanceolata, basin versus angustissima, cum majore omnino connata.

Formosa: Prov. Taihoku, jenseits Urai, selten auf Felsen und Gebirgsrücken in wintergrünen Mischwäldern, in 200 m Meereshöhe, Baum 12—23 m hoch, 1,5—3,5 m in Diameter, mit jungen ♀ und einzelnen reifen ♂ Zapfen, 31.V. 1918, ges. E. H. Wilson (Arnold Arboret. Exped. to Eastern Asia, 1917—1918, n. 10267); jenseits Urai, steriler Bergabhang in Lauraceen-Wald, in ca. 150 m Meereshöhe, steril, 30.III. 1912, ges. W. R. Price (n. 344); jenseits Urai, in Lauraceen-Wald, in ca. 150 m Meereshöhe, steril, XII. 1909, ges. T. Kawakami und S. Susaki; Taihoku, angepflanzt, mit reifen ♀ Zapfen, 5.IX. 1918, ges. E. H. Wilson (Arnold Arboret. Exped. to Eastern Asia, 1917—1918, n. 10960); Rinkosho, ca. 5 km östlich Taihoku, unter chinesischen Häusern, Baum 18 m hoch, 2 m in Diameter, mit jungen ♀ und einzelnen reifen ♂ Zapfen, 1.IV. 1918, ges. E. H. Wilson (Arnold Arboret. Exped. to Eastern Asia, 1917—1918, n. 10270); Rinkosho, IX. 1906, ges. T. Kawakami und U. Mori (nach Hayata loc. cit.); Tansui, steril, VII. 1888, ges. F. S. A. Bourne;[1] ?Lunnsha in der Umgebung von Tooseikaku, 1897, ges. Y. Satake;[1] ?Kasinsha, ges. C. Owatari (die beiden letzten Lokalitäten nach Matsumura, loc. cit.).

Hayata (loc. cit.) hat die ♂ Zapfen und die Samen beschrieben. Nach der Zeichnung zu urteilen, standen ihm aber nicht reife ♂ Zapfen zur Verfügung. Die Angabe, dass sie nur aus ca. 8 Mikrosporophyllen zusammengesetzt sind, ist unrichtig. Die Anzahl beträgt, wie in der Diagnose erwähnt ist, ca. 16—18.

Wilson (loc. cit.) erwähnt, dass diese Art vom zentralen Teil von Formosa nordwärts zwischen ca. 45 und 450 m Meereshöhe verbreitet aber nirgends häufig ist. In den Fällen, wo sie wirklich wildwachsend angetroffen worden ist, kommt sie auf sterilen Felsenabhängen oder auf den Kanten von scharfen Felsenvorsprüngen, also an fast unzugänglichen Stellen, vor. Der grösste von den von Wilson gesehenen lebenden Bäumen war ca. 23 m hoch und hatte einen Stamm, dessen Umfang am Grunde 3 m mass, aber es wurden auch Baumstümpfe von 5—5,5 m Umfang an-

[1] Diese Lokalitäten sind von Matsumura (loc. cit.) angeführt. Da ich aber keine Exemplare gesehen habe und Matsumura keine Abbildungen gegeben hat, bleiben die Angaben etwas unsicher.

getroffen. Die Krone ist breit, mehr oder weniger abgeflacht aber ziemlich licht und wird von mehreren dicken Hauptästen und vielen dünnen, spreizenden, horizontalen oder aufsteigenden Ästen zweiter Ordnung aufgebaut.

Das Holz von *Libocedrus formosana* ist nach Wilson für Kunsttischlerei, Möbeltischlerei u. dgl. das beste und wertvollste auf Formosa, und ausserdem werden die Sägespäne bei der Herstellung von Weihrauchhölzchen und die Rinde bei Dachdeckung benutzt.

Bis ungefähr im Jahre 1908 war nach Wilson dieser wertvolle Baum häufig in der Provinz von Taihoku, ist aber seitdem durch zu starke Inanspruchnahme für die soeben genannten Zwecke im wildwachsenden Zustande eine Seltenheit geworden.

So viel ich weiss, ist *Libocedrus formosana* noch nicht in Europa eingeführt worden.

Saxton (Ann. of Bot., XLIV, 1930, p. 168) hat neulich die Blätter eines im Temperate House, Kew Gardens, gezüchteten Exemplares von *Libocedrus macrolepis* anatomisch untersucht. Ob dieses schon typische Folgeblätter trägt, ist mir nicht bekannt. Es scheint mir nicht unmöglich, dass es sich in dem von Saxton untersuchten Material statt dessen um Übergangsblätter gehandelt hat, die allerdings nur verhältnismässig wenig von den Folgeblättern abweichen (durch ihre Länge, den Grad der Kutinisierung usw.). Die untersuchten Zweiglein waren natürlich dorsiventral ausgebildet. Die Oberblätter der Fazialblätter sind hinsichtlich der Verteilung des Assimilationsparenchyms invers-dorsiventral, die Unterblätter scheinen überhaupt keine Palissaden zu entwickeln. Die Marginalblätter sind einseitig invers-dorsiventral, in dem sie auf der dem Lichte exponierten Längshälfte der Unterseite Palissaden ausbilden, auf der anderen Längshälfte und auf der Oberseite aber nicht. *Libocedrus formosana* dürfte sich in ganz derselben Weise verhalten.

Was die Epidermisstruktur betrifft, zeigen die Folgeblätter der Zweiglein der letzten Ordnungen der ostasiatischen *Libocedrus*-Arten folgende Merkmale. Sie sind amphistomatisch, d. h. tragen auf beiden Blattseiten Spaltöffnungen, oder ausnahmsweise (Oberblätter der Fazialblätter) epistomatisch, d. h. sind mit Spaltöffnungen nur auf der Oberseite versehen. Die Unterblätter der Fazialblätter tragen auf der Oberseite zwei schmale, dem Blattrande parallel laufende, nicht herablaufende papillöse Spaltöffnungs-

streifen, die apikalwärts oft über der Medianlinie kurz vereinigt sind und kurz vor dem Grunde der freien Lamina endigen. Die Spaltöffnungsstreifen werden von unregelmässig angeordneten und gerichteten Spaltöffnungsapparaten gebildet. Die Unterseite der Unterblätter trägt zwei dreieckige, am Grunde der freien Lamina ziemlich breit beginnende und basalwärts weit ausgezogene, papillöse Spaltöffnungsstreifen, die aus ziemlich gleichmässig dicht, aber unregelmässig angeordneten und regellos orientierten Spaltöffnungsapparaten bestehen. Die Oberblätter der Fazialblätter besitzen eine mit der der Unterblätter übereinstimmenden Oberseite. Auf ihrer Unterseite sind aber die Spaltöffnungsstreifen sehr stark, bis auf einzelne Apparate, reduziert oder gänzlich unterdrückt. Die Marginalblätter zeigen auf der Oberseite, ähnlich den Fazialblättern, zwei papillöse Spaltöffnungsstreifen, die sich aber auf den herablaufenden Leisten der oberseitigen Lamina fortsetzen. Diese Streifen können bei *Libocedrus formosana* im freien Teil der Blätter hinsichtlich der Anzahl der Spaltöffnungsapparate mehr oder weniger reduziert sein. Auf den herablaufenden Leisten bestehen die Streifen stets aus ziemlich gleichmässig dicht, aber unregelmässig angeordneten und regellos orientierten Spaltöffnungsapparaten. Auf der Unterseite der Marginalblätter findet eine gänzliche Unterdrückung desjenigen Spaltöffnungsstreifens statt, der auf der dem Lichte zugekehrten Längshälfte zu liegen gekommen wäre. Auf der anderen Längshälfte findet man einen sogar bis zur halben Länge der freien Lamina reichenden, apikalwärts langsam verschmälerten papillösen Spaltöffnungsstreifen, der gleichfalls aus unregelmässig angeordneten und regellos orientierten Spaltöffnungsapparaten besteht. Der Blattrand trägt sowohl im freien Teil der Fazialblätter, als auch im freien Teil und auf dem Polster der Marginalblätter verlängerte, in ihrer unteren Partie kammförmig zusammengefügte, aber in der oberen zahnartig vorspringende Randzellen.

Die homomorphen Folgeblätter der ♀ Zweiglein von *Libocedrus macrolepis* sind amphistomatisch. Ihre Oberseite stimmt gut mit der der Fazialblätter der sterilen Zweiglein überein. Auf der Unterseite besitzen sie am Grunde des Polsters zwei kleine papillöse Spaltöffnungsgruppen, die nur ganz wenige unregelmässig orientierte Spaltöffnungsapparate enthalten.

Es ist auch eine tertiäre *Libocedrus*-Art, *L. Lantenoisi* Laurent

(Laurent in C. R. Assoc. franc. pour l'avanc. des sci., XXXVIII, 616, 1910), aus Ostasien (Tonkin) beschrieben worden, die sowohl auf Grund sterilen sowohl als auch fertilen (♀) Materials begründet wurde. Laurent beschrieb die Zapfen in folgender Weise: »Le cone est formé de six écailles, les deux premières très petites munies à leur extrémité de deux pointes déjetées extérieurement et réfléchies vers la base; les deux suivantes disposées en croix ont 1 cm de hauteur sur 7 mm de large; elles portent à la partie supérieure très près du bord une petite pointe également déjetée vers la base; enfin les deux internes d'égale longueur portent un mucron érigé.» Nach dieser, von Abbildungen leider nicht begleiteten Beschreibung scheint es mir höchst wahrscheinlich, dass es sich tatsächlich um eine mit den rezenten ostasiatischen *Libocedrus*-Arten nahe verwandte Konifere handelt. Die Beschreibung der offenbar von den fertilen getrennt gefundenen sterilen Zweige ist dagegen recht unvollständig. Frln Colani (in Bull. Serv. Géol. de l'Indochine, IV: 1, p. 27, 1916, und in »Etude sur les flores tertiaires de quelques gisements de lignite de l'Indochine et du Yünnan», Thèse Paris, pp. 420, 424, 1920) hat auch ähnliche, aber lauter sterile Cupressaceen-Reste aus dem Tertiär von Tonkin beschrieben und abgebildet. Es ist ihr aber nicht gelungen, die systematische Stellung derselben klarzulegen. Sie hat die Epidermisstruktur der Blätter untersucht, aber leider in mangelhafter Weise, so dass keine sicheren Schlüsse gezogen werden können. Um sterile beblätterte Zweiglein von Cupressaceen bestimmen zu können, ist eine weit eingehendere Untersuchung der Epidermisstruktur sowohl der Fazial- als auch der Marginalblätter unbedingt erforderlich.

Naturhistorisches Reichsmuseum zu Stockholm, Paläobotanische Abteilung, Februar 1930.

TAFELERKLÄRUNG.

Tafel I.

Libocedrus macrolepis (Kurz) Benth.

Fig. 1. Sterile, dorsiventral ausgebildete, dimorph (oder trimorph, wenn man so will) beblätterte und fertile radiäre, homomorph beblätterte, je einen terminal gestellten ♀ Zapfen tragende Zweiglein; von den Zapfen ist der untere normal ausgebildet, bei dem oberen ist das

äussere Schuppenpaar fertil geworden, während das normal fertile steril geworden ist. — $^{3}/_{1}$. (A. Henry n. 11566 A, ex Herb. Mus. Berol.).

Fig. 2. Spross mit ♂ Zapfen. — $^{3}/_{1}$. (A. Henry n. 11566 B, ex Herb. Mus. Berol.).

Fig. 3. Junger ♀ Zapfen; das Zweiglein ist schon auf diesem Stadium deutlich von den sterilen abweichend. — $^{3}/_{1}$. (leg. Hole, ex Herb. Kew).

Fig. 4. Mikrosporophyll mit 4 Mikrosporangien. — $^{11,5}/_{1}$. (A. Henry n. 11566 B, ex Herb. Mus. Berol.).

Tafel II.

Fig. 1—5. *Libocedrus formosana* Florin n. sp.

Fig. 1. Spross mit mehreren sterilen und einem fertilen, einen terminal gestellten ♀ Zapfen tragenden Zweiglein, die alle dorsiventral ausgebildet sind und Marginal- und Fazialblätter tragen. — $^{3}/_{1}$. (E. H. Wilson n. 10960, ex Herb. Mus. Berol.).

Fig. 2. Reife ♂ Zapfen. — $^{3}/_{1}$. (E. H. Wilson n. 10267, ex Herb. Kew).

Fig. 3. Junge ♀ Zapfen. — $^{3}/_{1}$. (E. H. Wilson n. 10267, ex Herb. Kew).

Fig. 4. Samen. — $^{2}/_{1}$. (E. H. Wilson n. 10960, ex Herb. Mus. Berol.).

Fig. 5. Mikrosporophyll mit 3 Mikrosporangien. — $^{11,5}/_{1}$. (E. H. Wilson n. 10267, ex Herb. Kew).

Fig. 6. *Libocedrus macrolepis* (Kurz) Benth.

Fig. 6. Samen. — $^{2}/_{1}$. (A. Henry n. 11566 A, ex Herb. Mus. Berol.).

Svensk Botanisk Tidskrift. 1930. Bd. 24, H. 1.

PILGERODENDRON. EINE NEUE KONIFEREN-GATTUNG AUS SÜD-CHILE.

VON

RUDOLF FLORIN.

Während meiner bald abgeschlossenen Untersuchungen über die äussere Morphologie und Epidermisstruktur der Assimilationsorgane der rezenten Koniferen, die als Vorstudien zu einer kritischen Revision der fossilen Koniferen zu betrachten sind, begann ich mich besonders für die südchilenische Konifere *Libocedrus uvifera* (Don) Pilger unter den Cupressaceen zu interessieren, da sie eine isolierte Stellung innerhalb der Gattung *Libocedrus* einzunehmen schien. Die in dieser Richtung weitergeführte Untersuchung hat mich davon überzeugt, dass wir es hier mit einer in der Gesammtheit der Merkmale so stark von den übrigen *Libocedrus*-Arten abweichenden Form zu tun haben, dass sie zweckmässig als Vertreter einer eigenen, obwohl natürlich mit *Libocedrus* verwandten, Gattung angesehen werden soll. Ich benenne sie nach Herrn Professor Dr. Rob. Pilger, dem Bearbeiter der Koniferen in der zweiten Auflage des von Engler herausgegebenen Werkes »Die natürlichen Pflanzenfamilien»:

Pilgerodendron Florin n. gen. — Arbores (vel frutices) semper-virentes, dioicae, ramulis tetragonis, foliis homomorphis, decussatis, bifacialibus, epistomaticis, non scarioso-marginatis, patentibus—fere adpressis et imbricatis, strobilis solitariis, ad ramulos terminalibus. Strobili ♂ majusculi, subcylindrici, basi foliis 2 elongatis, tenuibus, inferne scarioso-marginatis cincti, sporophyllis magnis, decussatis, quadrifariam imbricatis, subpeltatis, brevipetiolatis, erectis, ovatis vel rhomboideis, ± longe acuminatis, sporangia subobtegentibus;

sporangia quoad numerum valde varia, in parte inferiore strobili vulgo 6 (4—8), apici petioli inserta, inter sese libera, intus longitrorsum dehiscentia. Strobili ♀ ovoidei vel ellipsoidei, basi foliis 4 decussatis, elongatis, tenuibus, scarioso-marginatis cincti; squamae 4, juveniles subcarnosae et marginibus papillosis cohaerentes, demum lignoso-coriaceae et valvatim separatae, dorso aculeo longo erecto-incurvo armatae, superiores 2 fertiles, obovato-oblongae, ovulis binis, erectis, inferiores 2 steriles, oblongo-lanceolatae, triente breviores; axis saepe in columellam vulgo brevissimam, ovoideam aut rarius subcylindricam excurrens. Semina (3—)4, obtuse trigona, alis 2, inter sese liberis, majore elongata, semen alte superante.

P. uvifera (Don) Florin n. comb.

Syn.: *Juniperus uvifera* Don in Lambert, Gen. Pinus, ed. 1, II, 17 (1824); *Thuja tetragona* Hooker in London Journ. of Bot., III, 148, t. 4 (1844); *Libocedrus tetragona* Endlicher, Syn. Conif., 44 (1847); *Libocedrus cupressoides* Sargent in Sylva N. Amer., X, 134 (1896); *Libocedrus uvifera* Pilger in Engler & Prantl, Natürl. Pflanzenfam., ed. 2, XIII, 389 (1926).

Verbreitung: im südlichen Chile 40°—55°, von Valdivia an südlich bis nach Feuerland. Nach Skottsberg [K. Svenska Vet. Akad. Handl., LVI: 5, 170 (1916)] im regenreichen Gebiet vorkommend und als Charakterbaum der Moorwälder zu bezeichnen.

Baum (Habitusbild in der soeben zitierten Arbeit von Skottsberg, Taf. 2, Fig. 1, links) bis 40 m hoch mit einem geraden Stamm, im südlichen Teil des Verbreitungsgebietes auch strauchartig wachsend; Äste abstehend bis ausgespreizt, stielrund, mit rauher Oberfläche, die von den Narben abgefallener Blätter gebildet wird, und von brauner Borke bedeckt, die sich in Lamellen ablöst. Zweige nach dem Ende der Äste zu unregelmässig gebüschelt, in zweireihig gestellte, abstehende, von Blättern dicht bedeckte, vierkantige Zweiglein auslaufend. Blattentwicklung homoblastisch. Blätter der Zweiglein letzter Ordnung dekussiert, homomorph, bifazial, inversdorsiventral, lederig, zu $^1/_4$ bis $^1/_2$ ihrer Länge an der Achse angewachsen, also herablaufend, mit einem freien Teil, der weit länger ist als der herablaufende, ± abstehend bis fast angedrückt, an der Spitze einwärts gekrümmt, ± locker bis dicht vierreihig imbrikat, eiförmig oder eiförmig-lanzettlich, in Profilstellung im freien Teil ± sichelförmig gebogen, stumpf oder spitz, unterseits konvex und in der Medianlinie ziemlich hoch und stumpf gekielt, oberseits schwach ausgehöhlt, fast kahnförmig, ganzrandig, nicht trockenhäutig, 2—4 mm lang, 1—1,5 mm breit. Sie sind epistomatisch, auf

der Unterseite also ganz ohne Spaltöffnungen; Oberseite mit bis zu $^1/_2$ oder der ganzen Länge nach über der Medianlinie vollständig vereinigten, nicht-herablaufenden, nicht-papillösen Spaltöffnungsstreifen, die aus sehr dicht angeordneten, ± unregelmässig verlaufenden Längsreihen von längsorientierten Spaltöffnungsapparaten gebildet sind.

♂ Zapfen endständig an Zweiglein, die in derselben Weise wie die sterilen beblättert sind, fast zylindrisch, stumpf, 5—10 mm lang, 2 mm im Durchmesser, am Grunde dicht von 2 dünnen, im unteren Teil am Rande trockenhäutigen, verlängerten Nadeln umgeben, von 24—36, dekussiert gestellten, vierreihig imbrikaten, eiförmigen oder rautenförmigen, an der Spitze ± ausgezogenen und grünlichen, stumpfen, am Rande teilweise trockenhäutigen, hypopeltaten, 1,5—2,5 mm langen und 1,5 mm breiten Sporophyllen gebildet; Sporangien fast kugelig oder oblong, der Anzahl nach sehr wechselnd, in der unteren Hälfte der Zapfen meist 6, obwohl normal zwischen 4 und 8 schwankend, ausnahmsweise bis 10 vorhanden; sie sitzen frei voneinander auf der Innenseite der Schuppe am Grund des Stieles befestigt und öffnen sich einwärts mit breitem, längsgestelltem Spalt. Pollen ohne Flugblasen.

♀ Zapfen endständig an Zweiglein, die in derselben Weise wie die sterilen beblättert sind, am Grunde von vier dekussiert gestellten, dünnen, am Rande trockenhäutigen, nur im apikalen Teil der Oberseite Spaltöffnungen tragenden, verlängerten (die oberen stärker als die unteren), spitzen Nadeln umgeben, von vier aufrechten, ungefähr in der Mitte des Rückens oder etwas höher hinauf mit pfriemlichem, einwärts gekrümmtem, unterseits konvexem, oberseits ausgehöhltem, den Blättern ähnlichem Dorn und wulstigen, papillösen Rändern versehenen, dekussiert gestellten, bifazialen Schuppen gebildet, eiförmig oder ellipsoidisch, 8—12 mm lang, 5—6 mm im Durchmesser; fertile Schuppen zwei an der Zahl, obovat-oblong, stumpf, flach, dick, wenn reif im oberen Teil abstehend; darunter zwei sterile oblong-lanzettliche, fast spitze Schuppen von etwa $^2/_3$ der Länge der fertilen; darüber entweder gar kein Fortsatz der Achse oder ein kurzer solcher von ovoider oder fast zylindrischer Gestalt. Zapfen sich klappig öffnend, im getrocknetem Zustande rötlich braun gefärbt, nach der Ausstreuung der Samen oft am Zweiglein sitzen bleibend und dann auf der Aussenseite der Schuppen grau, auf der Innenseite weisslich gefärbt; Schuppen wenn jung fast fleischig, wenn reif holzig-lederig. Samen

(3—)4 an der Zahl, am Grunde der fertilen Schuppen sitzend, blassgelbbraun, wenn trocken stumpf dreiseitig, 3 mm lang, am Grunde 1,5 mm im Durchmesser, mit mehreren (ca. 14) Harzgängen in der Schale und 2 ungleichen, voneinander freien Flügeln; grösserer, gegen den Rand der Schuppe gerichteter Flügel stark nach oben hin verlängert, schief obovat oder oblong, 6—7 mm lang, ca. 3 mm breit; kleinerer, nach innen gerichteter Flügel fast nur als schmaler Saum am Samen ausgebildet, nur wenig oder gar nicht über die Spitze des Samens reichend.

Im übrigen wird auf die illustrierte Darstellung in dem bald erscheinenden ersten Teil meiner Koniferen-Monographie hingewiesen.

Naturhistorisches Reichsmuseum zu Stockholm, Paläobotanische Abteilung, Anfang März 1930.

SMÄRRE MEDDELANDEN.

Föreningens medlemmar uppmanas, att till denna avdelning insända meddelanden om märkliga växtfynd o. d.

Några växtfynd inom Västerås hamnområde.

Under åren 1924—1928 hava provinsialläkaren O. Ohlin, drätseldirektören T. Öberg och undertecknad gjort en del växtfynd inom Västerås hamnområde, vilka fynd möjligen kunna vara av intresse. Inom nämnda område ha under de sista åren verkställts en del utfyllnadsarbeten, varför jord och avfall ditförts från olika delar av staden. En del av de funna växterna har tydligen ditkommit med jord och dylikt från läroverkets botaniska trädgård, och har jag vid dessa växter antecknat (Bot. tr.). Vid de av oss observerade växter, vilka professor G. Samuelsson i »Växtlokaler från Västmanland. I och II» (Sv. Bot. Tidskr., 1923, H. 4 och 1925, H. 1) uppgivit från Västerås, har jag antecknat (Sn.).

Professor G. Samuelsson, läroverksadjunkt T. Vestergren och konservator O. R. Holmberg hava godhetsfullt granskat och bestämt en del av de funna växterna.

Uppställningen och nomenklaturen äro huvudsakligen enligt Lindmans flora, 2:a uppl.

Zea mays L. *Echinochloa crus galli* R. et Sch. (Sn.). Ej efter 1925. *Panicum miliaceum* L. Blott 1924. *Setaria viridis* PB. (Sn.). *S. verticillata* PB. Två exemplar 1926. *Phalaris canariensis* L. (Sn.). *Apera spica venti* PB. *Cynosurus echinatus* L. Blott 1926. *Puccinellia distans* Parl. *Zerna inermis* Lindm. *Bromus arvensis* L. (Sn.). *Beckmannia eruciformis* Host. Ej återfunnen efter 1925. *Hordeum jubatum* L. *Allium montanum* F. W. Schm. (Bot. tr.). *Asparagus officinalis* L. Blott 1925. *Cannabis sativa* L. *Rumex salicifolius* Weinm. *Polygonum Bellardii* All. Ett exemplar 1926. *P. alpinum* All. Ett exemplar 1928. (Bot. tr.). *Fagopyrum sagittatum* Gil. Två små exemplar 1926. *Chenopodium botrys* L. Ej återfunnen efter 1926. *Ch. album* L. var. *spicatum* Koch. och var. *viride* Wg. *Ch. opulifolium* Schrad. Ett exemplar 1926. *Ch. vulvaria* L. *Ch. glaucum* L. (Sn.). *Ch. rubrum* L. (Sn.). var. *paucidentatum* Koch. och var. *nanum* Neum. *Atriplex hortense* L. (Sn.). (Bot. tr.). *Axyris amarantoides* L. *Malachium aquaticum* Fr. (Sn.). *Melandrium dioecum* Sch. et Thell. (Bot. tr.). *Gypsophila paniculata* L. Ett

exemplar 1927. *Vaccaria segetalis* Garcke. Ett exemplar 1926. *Delphinium consolida* L. *Chelidonium majus* L. var. *crenatum* Fr. (Bot. tr.). *Papaver argemone* L. Ett exemplar 1925. *P. somniferum* L. *Lepidium densiflorum* Schrad. *Sisymbrium Loeselii* L. (Sn.). *S. altissimum* L. (Sn.). *S. orientale* L. Ett exemplar 1926. *Isatis tinctoria* L. (Bot. tr.). *Diplotaxis erucoides* (L.) DC. Blott 1926. *Hirchfeldia Pollichii* Fritsch. Ett exemplar 1926. *Brassica oleracea* L. *B. juncea* Cass. *B. nigra* Koch. (Sn.). *Raphanus raphanistrum* L. *R. sativus* L. (Sn.). *Barbaraea stricta* Andrz. (Sn.). *Radicula amphibia* Druce f. *indivisa* DC. *Nasturtium anceps* (Wg.) DC. (Sn.). *Camelina microcarpa* Andrz. (Sn.). *C. sativa* Cr. *C. pilosa* (DC.) Zinger. Blott 1926. *Vogelia paniculata* Horn. Blott 1924. *Alyssum maritimum* (L.) Lam. (Sn.). Ej återfunnen efter 1925. *Berteroa incana* DC. (Sn.). *Hesperis matronalis* L. *Conringia orientalis* Dum. Ej efter 1926. *Reseda luteola* L. (Bot. tr.). *R. lutea* L. (Bot. tr.). *R. odorata* L. *Medicago falcata* L. Ett exemplar 1926. *Melilotus officinalis* Desr. (Sn.). Rikligt! *M. albus* Desr. (Sn.). *M. indicus* (L.) All. Ej efter 1926. *Galega orientalis* Lam. (Bot. tr.). Ett exemplar. *Vicia hirsuta* S. F. Gray. *V. tetrasperma* Moench. (Sn.). *V. angustifolia* Reichard. Blott 1925. *Geranium phaeum* L. f. *lividum* Pers. (Bot. tr.). *G. pratense* L. *Parthenocissus quinquefolia* Planch. Ett exemplar 1925. *Malva moschata* L. *Viola tricolor* L. var. *hortensis* DC. Ett exemplar 1926. *Epilobium hirsutum* L. (Bot. tr.). *E. rubescens* Rydb. (Sn.). *Oenothera biennis* L. Ej efter 1927. *Aralia racemosa* L. Ett exemplar, vilket blommade 1927. *Eryngium planum* L. Två exemplar 1925. *Anethum graveolens* L. *Pastinaca sativa* L. (Sn.). Rikligt! *Lysimachia nummularia* L. (Bot. tr.). *Convolvulus sepium* L. (Sn.). *Lappula echinata* Gil. *Asperugo procumbens* L. (Sn.). *Anchusa officinalis* L. Vitblommig. (Bot. tr.). *Nepeta grandiflora* MB. (Bot. tr.). *Solanum tuberosum* L. *S. nigrum* L. *S. luteum* Mill. Ett litet exemplar 1926. *S. rostratum* Dural. Ett exemplar 1925. *Lycopersicum esculentum* Mill. (Sn.). *Datura stramonium* L. Blott 1925. *Chaenorrhinum minus* Lge. (Sn.). *Dipsacus pilosus* L. (Sn.). *Bryonia alba* L. *Eupatorium cannabinum* L. (Bot. tr.). *Bellis perennis* L. Ett exemplar 1926. *Aster salignus* Willd. *A. chinensis* L. Ett exemplar 1926. *Inula britanica* L. var. *serrata* Gilib. *Helianthus annuus* L. *H. tuberosus* L. Ej blommande. *Guizotia abyssinica* (L. fil.) Cassini var. *sativa* (DC.) Oliver et Hiern. Blott 1924. *Artemisia biennis* Willd. Ej efter 1925. *Calendula officinalis* L. *Arctium lappa* L. *Cirsium arvense* Scop. var. *integrifolium* W. et Gr. *Cichorium intybus* L. (Sn.). *C. intybus* var. *sativum* Bischoff. Ett exemplar 1925. *Lactuca scariola* L. (Sn.). Rikligt! *L. scariola* f. *integrifolia* Bischoff.

Västerås den 10 augusti 1929.

Arwid Wollert.

Diskoid form av Achillea millefolium.

Det är väl känt, att några compositéer, som normalt sakna kantblommor, understundom ha sådana, exempelvis *Senecio vulgaris* och *Bidens*-arter. Mera allmänt är dock, att compositéer, normalt försedda med kantblommor, ibland sakna sådana; *Chrysanthemum leucanthemum, Matricaria*

inodora och *maritima*, *Anthemis tinctoria*, några *Senecio*-arter, *Aster tripolium* och *Centaurea scabiosa* äro att räkna dit. I den litteratur, som varit mig tillgänglig, har jag ej bland dessa s. k. diskoidformer sett *Achillea millefolium* angivas.

Den påträffades emellertid av mig sommaren 1913 i Ramsele, Västernorrlands län. Växtplatsen var en åker, som synbarligen några år legat i träda. Den utgjordes av sandmylla, omfattade flera tunnland och var belägen mellan landsvägen och kyrkan På ett par kvadratmeters yta växte ganska tätt omkring ett 30-tal individ, av vilka 10 insamlades. Jag strövade länge omkring på åkern i hopp att finna flera kolonier eller enstaka exemplar men utan resultat, ehuruväl av huvudformen funnos tusental. År 1917 hade jag tillfälle att åter besöka Ramsele. Åkern var då till hela sin vidd besådd med havre och blandsäd. Även vid ett senare besök i år befanns åkern ligga under plog.

Ett ark av det insamlade materialet insändes på sin tid till Riksmuseum.

Härnösand i aug. 1929. *Nils Johnsson.*

Paktesuolo i Tjeggelvas, ett sydberg.

Sommaren 1928 tog jag mig, ej utan möda och sedelutgivning, upp till nordvästra ändan av sjön Tjeggelvas, som genomflytes av Pite älv i dess övre lopp. Oklanderlig bostad och kost hade jag hos en lapp i byn Västerfjäll. En god säng i ordentligt möblerat rum och servett vid måltiderna. Under ett par veckors vistelse där gjorde jag åtskilliga dagsutflykter bl. a till holmen Paktesuolo, belägen mitt i den långsträckta Tjeggelvas och känd som en av de mycket få (en tid den enda) växtplatserna i Sverige för *Potentilla multifida* L., där upptäckt emot slutet av 1800-talet. Men holmen förtjänar även eljest ett uppmärksammande, enär dess växtlighet i mycket avviker från omgivningens. Paktesuolo håller i areal några få tunnland (högst 5), är tämligen smal och höjer sig från nordväst till sydost, där den stupar brant med en höjd av omkring 100 meter. Det är å detta stup och mest vid dess fot (raset), som de för orten mera ovanliga växterna förekomma. Jag antecknade följande:

Hieracium diaseratum Om. *H.* (ännu obestämd *silvaticum*-form). *Veronica officinalis* L., *Lappula deflexa* Garcke., *Viola montana* L., *Draba rupestris* R. Br., *Erysimum hieraciifolium* L., *Turritis glabra* L., *Barbarea stricta* Andrz., *Ribes rubrum* L. (bildande rätt svårgenomträngligt snår), *Silene rupestris* L., *Urtica dioica* L. var. *subinermis* Uechtr., *Poa glauca* M. Vahl., *P. alpina* L. och *Melica nutans*.

Största delen av holmen har vanlig fjällhedsnatur, där *Dryas, Diapensia, Phyllodoce, Loiseleuria, Salices* m. fl. ingå i vegetationen. Själva stupet är något längre upp oåtkomligt för undersökning. På hyllor eller utsprång växer *Potentilla multifida* jämte andra växter, omöjliga att utan kikare särskilja. Till hyllorna kan man endast komma genom att ovanifrån (med rep) fira sig ned. *Potentilla multifida* är där utan fridlysning nog så väl skyddad.

Teckomatorp i jan. 1930. *Nils Johnsson.*

Oenanthe Lachenalii i Sverige.

År 1927 upptäckte undertecknad på en liten holme norr om Espeholmen (generalstabskartans Aspön, under Droppemåla hemman) i Ronneby skärgård en misstänkt umbellat, som vid undersökning visat sig vara den bl. a. på tyska östersjökusten förekommande *Oenanthe Lachenalii* Gmel. Den växte på ett vid kraftigt högvatten översvämmat stycke av stranden, spridd i ett rikt bestånd av *Juncus maritimus*. Lokalen skuggas delvis av några alar, varför de flesta exemplaren äro relativt bleka och spensliga. Förekomsten, som 1927 var ymnig, var 1928 åter sparsam, men uppgick 1929 till åtminstone 90 större och mindre exemplar, av vilka ett 20-tal samtidigt blommade. Då lokalen endast omfattar holmens norra strand och då holmen endast mäter några få meter i längd och bredd, innebär detta tal en relativt ymnig förekomst. Egendomligt nog har varken *Oenanthe* eller *Juncus maritimus* anträffats på någon av holmarna runt omkring eller på det närliggande fastlandet.

Av allt att döma är förekomsten ursprunglig. En spridning genom människor är knappast tänkbar, dels på grund av växtens hela karaktär, dels emedan holmen så gott som aldrig besökts av människor. Dennas belägenhet längst in i skärgården gör dessutom osannolikt, att *Oenanthe* skulle direkt ha spritts från den närmaste, på andra sidan Östersjön belägna delen av sitt utbredningsområde. Möjligen är väl denna lokal en rest av ett fordom sammanhängande utbredningsområde längs södra Östersjöns stränder.

Nils Söderström.

Några adventivväxtfynd i Stockholmstrakten.

De små bidrag till Stockholmstraktens flora, jag nedan kommer att lämna, äro resultaten av exkursioner, som jag på lediga stunder företog under sommaren 1929, då jag hade min verksamhet förlagd till huvudstaden. Jag har funnit det lämpligt att uppdela materialet på två avdelningar efter de funna växternas förekomst och proveniens. Det i den senare delen nämnda Riddersvik betecknar sopstationen vid R. i Järfälla, den för Stockholmsbotanisterna välbekanta och trots sin horribla atmosfär gärna uppsökta adventivväxtlokalen. Jag har utelämnat sådana arter, som, efter vad jag med visshet vet, iakttagits på sina lokaler år efter år och som förefalla att kunna hålla sig kvar, för så vitt inga större omvälvningar ske på platsen. Skulle emellertid någon av mina fyndlokaler vara känd tidigare, hoppas jag, att ompubliceringen ursäktas. Till de nedan nämnda personer, som välvilligt givit mig bestämningshjälp eller fynduppgifter, ber jag att få framföra min tacksamhet.

I. Skeppsholmen, i gräsmattor.

Trisetum flavescens (L.) PB. — Denna även talrik i gräsmattor vid Blockhusudden.

Arrhenatherum elatius (L.) M. & K.

Festuca heterophylla Lam.
F. capillata Lam. [= *F. ovina* L. var. *tenuifolia* (Sibth.) Dum.].
Ranunculus Steveni Andrz. (steril).
Thlaspi alpestre L.
Erysimum sp. — I en gräsmatta, där f. ö. inga inkomlingar iakttogos, fann jag ett individ av en *Erysimum*-art med lysande orangegula blommor. Tyvärr hade stammen tidigt blivit avslagen; jag fann därför endast blommande basala ersättningsskott. Ehuru hjälp vid bestämningsförsöken välvilligt lämnats mig från flera håll, måste jag alltjämt beteckna mitt fynd som »*Erysimum* sp.», och även denna beteckning är ej alldeles säker, ty såsom amanuens C. Blom (Göteborg) påpekat, föreligger här möjligen en hybrid mellan en *Erysimum*- och en *Cheiranthus*-art (märk blomfärgen). Närmast låge ju till hands att misstänka någon av de arter eller hybrider, som på kontinenten iakttagits införda på liknande sätt eller som där odlas och stundom finnas förvildade. Sådana äro *Erysimum Marschalli* Bois. (= *Cheiranthus Allionii* hort.) och *E. Perofskianum* Fisch. & Mey., men enligt professor R. Nordhagen (Bergen) föreligger ingen av dessa i förhandenvarande fall. Av övriga vore väl endast *E. suffruticosum* Spreng. att tänka på, helst som avbildningarna av densamma i Hegis Ill. Flora von Mittel-Europa (Bd. IV: 1, sid. 426) och i Reichenbachs Icones Florae Germanicae (Fig. 4391) ej tala absolut emot ett sådant antagande. Att blommorna på det av mig funna exemplaret voro betydligt mindre (kronbladen ungefär som hos *E. hieraciifolium* L.) än på de avbildade, kan ju möjligen tillskrivas den bistra behandling, det förra undergått. Det obetydliga material, jag sett av *E. suffruticosum* (i Riksmuseet och Uppsala botaniska museum), visar emellertid så stora olikheter gentemot Skeppsholmsväxten, att jag ej anser mig kunna hänföra denna till nämnda art. Ej heller har jag i nämnda samlingar funnit någon annan *Erysimum*- eller *Cheiranthus*-art, med vilken den visar någon större överensstämmelse. Slutligen ha även prof. K. Linkola och dr. H. Lindberg (Helsingfors) haft vänligheten att granska mitt exemplar; den senare anser emellertid detta obestämbart, dock snarare hörande till en *Cheiranthus*- än till en *Erysimum*-art.
Potentilla norvegica L. — Ett stort individ.
Viola odorata L.
Epilobium roseum (Schreb.) Retz.
E. rubescens Rydb. (enl. Lindmans Flora). — Småväxt; delvis bleka former, vuxna under bersåbuskar etc. Å Kastellholmen såg jag ett ind. bland fallförna i berg. Jfr nedan.
Thymus Chamaedrys Fr. — Även i gräsmattor vid Blockhusudden.
Galium Mollugo L.
G. pumilum Murr. (*G. silvestre* Poll.). — Även i gräsmatta vid Lejonslätten på Djurgården.
Bellis perennis L. — Talrik i en gräsmatta; en form med små, »enkla» korgar, tydligen inkommen med gräsfröet.
Centaurea Cyanus L. — På en nysådd fläck ganska talrik.

Om de olika arternas — i synnerhet gräsens — resp. frekvens har jag svårt att med bestämdhet säga något, då gräsmattorna redan före mitt

första besök blivit slagna. Detta gjorde, att jag t. ex. av *Festuca*-arterna endast kunde finna några få fertila strån: åtminstone ett par tämligen stora tuvor ansåg jag mig dock på grund av deras ytterligt fina skottblad med säkerhet kunna räkna som *F. capillata*. Vid *F. heterophylla*-förekomsten fanns det visserligen gott om sterila *Festuca*-skott, men om alla dessa hörde till sistnämnda art eller en del till finbladiga former av *F. rubra* L., vågade jag ej avgöra. Jag hoppas att under kommande säsong skall ges möjlighet för mig eller någon annan att bringa klarhet härutinnan.

Det återstår även att identifiera ett par *Hieracium*-arter, av vilka jag tyvärr ej kom att insamla något material. En av dem är väl antagligen *H. grandidens* Dt, som bildar ett rätt stort bestånd på Kastellholmen (det. G. Samuelsson). De förekomma i en av de större gräsmattorna, vilken även hyste *Thymus Chamaedrys* och *Galium pumilum*, blandade med varandra och bägge talrika, samt slutligen i mindre mängd *Viola odorata* och *Galium Mollugo*. Den sistnämnda fanns möjligen på flera ställen, däremot ej de övriga. Återstoden av de funna arterna växte endast på var sin lilla fläck. Undantag utgjorde *Epilobium rubescens*, som fanns på ett par håll (möjligen även *E. roseum*), men det är att märka, att de båda Epilobierna säkerligen inkommit från närliggande lokaler, från vilka frön förts över av vinden, i motsats till de övriga uppräknade arterna. Att dessa senare införts med gräsfrö, anser jag alldeles visst. (*Viola odorata* kan ju dock vara utkommen från någon täppa eller rent av direkt planterad i gräset.) Tydligen har insåningen av de nuvarande gräsmattorna skett vid olika tider och med olika fröblandningar; när detta skett och vad som från början avsiktligt såtts in i de olika mattorna, känner jag tyvärr ingenting om. Att få några direkta uppgifter härom vore synnerligen intressant men torde väl knappast vara möjligt. I varje fall rekommenderas Skeppsholms-floran till vidare studium för Stockholmsbotanisterna. (Påpekas bör dock kanske, att gräsmattorna ej få beträdas och att flottister bevaka dem.) Samtidigt vill jag uppmana våra florister att överhuvudtaget, så ofta tillfälle yppar sig, göra iakttagelser över främmande växter, inkomna med gräsfrö, över deras beständighet och den använda frövarans sammansättning.

II. Ruderatplatser etc.

Phleum nodosum L. (enl. Sterner i Lindmans Flora, 2. uppl.). — Frihamnen, ett jätteindivid tillsammans med *Phleum pratense* L. å ruderatmark (tegelavfall o. d.).

Avena Fatua L. var. *glabrata* Peterm. — Frihamnen.

A. sterilis L. — Riddersvik.

Lolium rigidum Gaud. — Frihamnen.

Agropyron tenerum Vasey (det. T. Vestergren). — Frihamnen, en stor tuva.

Hordeum jubatum L. — Frihamnen.

Atriplex litorale L. — Riddersvik, talrik på en äldre avfallshög.

Chenopodium Zobelii Ludw. & Aellen. — Jag hade med ledning av Riksmuseets samlingar bestämt denna till *C. borbasioides* Ludw., men enligt meddelande av amanuens C. Blom, som varit vänlig att granska mitt material, är *C. Zobelii* det rätta namnet på de i Skandinavien funna former,

han tidigare betecknat som *borbasioides* Ludw.; det senare är ett nomen nudum.

Silene noctiflora L. — Värtans bangård.

Sisymbrium altissimum L. — Östra station, bangården, ett litet individ; upplagsplats vid hörnet av Banergatan och Valhallavägen.

Lepidium densiflorum Schrad. — Östra station, bangården, ganska talrik.

Sinapis alba L. — Stadsgården, nära Saltsjöbanans station.

Brassica nigra (L.) Koch. — Stadsgården, tillsammans med föregående; Frihamnen, fåtalig.

B. juncea (L.) Coss. — Stadsgården, tillsammans med föregående; Riddersvik.

Arabis suecica Fr. — Östra station, på bangården, ej särdeles talrik.

A. arenosa (L.) Scop. — Östra station, på bangården, dock ej blandad med föregående, ett par individ. Fil. dr. Erik Almquist har meddelat mig, att han redan år 1921 här såg ett rikt *Arabis*-bestånd, men att han ej sett efter, vilken art som bildade detta eller om ev. båda de nämnda funnos där. Vid Söder Mälarstrand, nedanför Münchens bryggeri, talrik. Djursholm, flerstädes ± talrik på järnvägsslänter och bangårdar (N. H. och Erik Almquist; av den senare tagen redan 1921 vid Ösby station enligt ex. i Riksmuseet).

Conringia orientalis (L.) Andrz. — Frihamnen, ett litet individ.

Lens culinaris Medik. (*Ervum Lens* L.). — Stadsgården, några individ i det ovannämnda *Brassica-Sinapis*-beståndet.

Vicia sativa L. — Östra station, bangården, ett litet individ.

Epilobium rubescens Rydb. — Upplagsplats vid hörnet Banergatan—Valhallavägen (mest dvärgexemplar); Beckholmen; Östra station, ett litet individ inne på bangården, eljes talrik därintill i den sprängda bergbranten vid Djursholmsbanan (på samma sätt som vid översta Regeringsgatan, S. Mälarstrand och Stadsgården; på Skansen såg jag ett par individ nedanför berget vid stora uppfartsvägen). Ytterligare ett par lokaler torde vara av intresse: Djurgården, Thielska galleriet, ett individ; Lovö, Drottningholm, ett par stora individ i slottsparken; Österåker, Resarö, villatomt på norra sidan, ett ind. på grusplan.

Anthemis Cotula L. — Frihamnen.

Nils Hylander.

Var finns Potentilla croceolata?

Undertecknad vore hrr botanister mycket förbunden för benägen upplysning om nu kända eller under instundande sommar eventuellt upptäckta fyndställen på Sveriges fastland för den hittills sannolikt förbisedda *Potentilla croceolata* (desslikes om trakter, där den förgäves eftersökts). Även uppgifter om *P. Tabernaemontani* (förekomst eller icke förekomst) vore av värde. — Min avsikt vore en utredning rörande behovet av skydd för dessa arter, särskilt med tanke på den fara, som hotar dem genom den vidgade beteskulturen.

Meddelande utbedes före augusti månads utgång.

Skara i mars 1930. *Alfr. Stalin.*

SAMMANKOMSTER ÅR 1929.

Vetenskapsakademien.

Den 9 januari.

Till införande i Vetenskapsakademiens Handlingar antogs: »Flora of Kamtchatka and the adjacent islands III» av fil. mag. Eric Hultén.

Den 23 januari.

Till införande i Arkiv för Botanik antogs: »*Hieracia tridentata* Fr.» av fil. dr. K. Johansson.

Den 27 februari.

Akademien beslöt förorda bifall till en ansökan av fil. lic. R. Florin om ett understöd på 6,000 kr. för utgivande av »Untersuchungen zur Stammesgeschichte der Coniferales und Cordaitales».

Professor O. Rosenberg höll ett föredrag om »Partenogenes hos växterna.»

Det meddelades, att Större akademiska konsistoriet i Uppsala till innehavare av var sitt Letterstedts inrikes resestipendium utsett docent G. E. Du Rietz och fil. mag. Gunnar Johansson.

Fil. dr. H. Dahlstedt tillerkändes Letterstedtska understödet för särskilt maktpåliggande vetenskapliga undersökningar för arbete å 4:de delen av monografien »De svenska arterna ur släktet *Taraxacum*».

Den 13 mars.

För resor inom Sverige i botaniskt syfte utdelades följande understöd:

Fil. kand. Gunnar Nilsson 200 kr. för undersökning av de västliga lavarnas utbredningsförhållanden;

Lektor Rikard Sterner 175 kr. för fullbordande av en växtgeografisk undersökning i södra Kalmar läns skärgård;

E. o. amanuens Seth Nilsson 100 kr. för insamlande av plankton från skånska märgelgravar och dammar;

Fil. stud. Åke Gustafsson 200 kr. för fortsatta cytologiska, geografiska och genetiska studier beträffande de svenska björnbärsarternas uppkomst och utveckling;

Fil. stud. Sven Borgman 150 kr. för fortsättande av floristiska och växtgeografiska studier i Lurö skärgård i Vänern.

Det meddelades, att Krokska kommittén tilldelat museiassistenten E. Asplund och tullförvaltaren A. Lindström var sitt resestipendium på 600 kr. Till införande i Vetenskapsakademiens Handlingar antogs: »A monography of the genus *Acarospora*» av fil. mag. A. H. Magnusson.

Den 10 april.

Akademien beslöt att till Sveriges representant vid V. internationella botaniska kongressen i Cambridge 1930 föreslå professor N. E. Svedelius och till suppleant för honom professor H. Kylin.

Till införande i Arkiv för botanik antogs: »Über das Vorkommen von Mollusken in den Luftblasen von *Ascophyllum nodosum*» av fil. stud. Th. Arwidsson.

Den 25 april.

Till införande i Arkiv för botanik antogs: »Lavar, hemförda av den svenska expeditionen till Jan Mayen och nordöstra Grönland» av lektor G. O. Malme.

Den 8 maj.

Till införande i Arkiv för botanik antogs: »Zur Kenntnis der Anonaceenflora von Haiti» av professor R. E. Fries och till införande i Acta Horti Bergiani: Zytologische Studien innerhalb der Gattung *Eremurus*» av fil. mag. H. Burström.

Den 22 maj.

Följande naturskyddsstipendier utdelades:

Fil. stud. Erik Julin 250 kr. för fortsatt undersökning av vegetationen på de genom sänkning nybildade öarna i Hjälmaren kring ön Valen och för jämförande studier av vegetationen på ett antal öar av samma natur i sjön Sottern;

Fil. stud. Gustaf Sandberg 175 kr. för undersökning av Biluddens vegetation med särskild hänsyn till *Hippophaë*-snåren;

Fil. lic. Anton Sörlin 300 kr. för undersökning av några i naturskyddshänseende intressanta områden i Härjedalen och sydvästra Jämtland.

Den 5 juni.

Till införande i Akademiens Handlingar antogs »Beiträge zur Morphologie und Entwicklungsgeschichte der Rhamnaceen» av professor H. O. Juel.

Till införande i Arkiv för botanik antogos: »Xyridaceæ brasilienses Hilairianæ» av lektor G. O. Malme; »Plants of Navassa Island, West Indies» av fil. dr. E. L. Ekman; »Plantæ Haitenses et Domingenses novæ vel criticæ VII a cl. E. L. Ekman 1924—1928 lectæ» av Geheimrat I. Urban.

Den 11 september.

Akademien tillerkände disponenten Sten Grapengiesser sin större Linnémedalj i silver som belöning för de stora tjänster, han gjort Riksmuseets paleobotaniska avdelning.

Det meddelades, att till Regnellsk amanuens antagits lektor G. O. Malme.

Till införande i Arkiv för botanik antogs: »Porinæ et Phylloporinæ in Itinere Regnelliano primo collectæ» av lektor G. O. Malme.

Den 9 oktober.

Till införande i Arkiv för botanik antogs: »Beiträge zur Algenflora von Schweden. 4» av fil. dr. O. Borge.

Den 13 november.

Till införande i Arkiv för botanik antogs: »*Plagiocystia verrucosa* n. sp.» av frih. A. v. Klinckowström, och i Skrifter i naturskyddsärenden: »Floran inom Sonfjällets nationalpark» av fil. stud. Th. Arwidsson.

Den 4 december.

J. A. Wahlbergs resestipendium tilldelades professor Th. C. E. Fries för en botanisk forskningsresa till Sydafrika och tropiska Afrika.

Botaniska Sektionen av Naturvetenskapliga Studentsällskapet Uppsala.

Den 21 september.

Sammanträde på Rosersberg.

Professor R. Sernander demonstrerade park- och trädgårdsanläggningarna och gav en allmän översikt över deras historia vid de uppländska godsen.

Den 8 oktober.

Docent O. Dahlgren höll föredrag om »Kön och katalasproduktion». Inledningsvis redogjordes för de i våras offentliggjorda undersökningarna av v. Euler och hans medhjälpare, varigenom uppvisats, att hos vissa mutantpar av korn går en utklyvning i förhållandevis katalasrika och katalasfattiga individer parallellt med utmendlingen av gröna och klorofyllösa sådana.

Föredr. hade undersökt ett par dioeciska växter för att se, om också de båda könen utmärktes av en olika katalasproduktion. Honblommor av *Urtica dioeca* sönderdelade genomgående vätesuperoxid starkare än hanblommor. Bladen visade däremot ej någon särskild olikhet i detta avseende. — Hos *Rumex acetosella* utmärktes däremot hanblommorna i allmänhet av en större katalashalt än honblommorna. De växlande förhållandena hos bladen synas ej berättiga till att — vad dem beträffar — anse katalasproduktionen som en könskaraktär. — Hos rödalgen *Polysiphonia nigrescens* voro de erhållna värdena mycket olika i två skilda kollekter, men könsindividen synas vara katalasrikare än tetrasporexemplaren.

Föredragarens resultat äro sålunda ej sammanfallande med dem, som Camp nyligen offentliggjort. Hos ett 10-tal av honom undersökta fanero-

gamer visade såväl blommor som blad den största kataláshalten hos det hanliga könet. (Se Bot. Not., 1929, sid. 341.)

(Autoreferat.)

Fil. stud. N. Hylander berättade minnen från de nordiska biologernas och geologernas möte på Hindsgavl på Fyn före årets naturforskarmöte i Köpenhamn och visade i samband därmed talrika bilder.

Den 22 oktober.

Professor N. Svedelius höll föredrag om »Nyare upptäckter angående floridéernas tetrasporbildning», därvid huvudsakligen uppehållande sig vid Kolderup-Rosenvinges undersökningar (1929) över förhållandet mellan släktena *Actinococcus* och *Phyllophora*, varav framgått, att *Actinococcus* vore att betrakta som *Phyllophora's* starkt reducerade tetrasporalstrande generation. *Actinococcus* såsom släkte bör således alldeles slopas. Föredr. redogjorde även för Börgesens upptäckt 1927 av *Liagora tetrasporifera*, som bildar tetrasporer i gonimoblastgrenens spetsar. Även om dessa typers reduktionsdelning ej ännu vore cytologiskt fastställd, betraktades de av föredr. som ytterligare bevis för den av honom en gång framställda teorien, att hos floridéerna reduktionsdelningens plats i utvecklingens gång kan förskjutas.

(Autorefererat.)

Professor C. Th. Mörner visade en vacker kollektion av *Geaster triplex* Jungh. från Marstrand, vidare pressat material och frukter av bignoniacéen *Jacaranda ovalifolia* R. Br. från Cagliari på Sardinien och levande material av rubiacéen *Nertera depressa*, som denna höst synes ha gjort ett återinträde i blomsterhandeln.

Den 19 november.

Fil. stud. D. Lihnell höll ett föredrag över »Några bidrag till anatomien hos *Strychnos Tieute*». Föredraget illustrerades med bilder ur tryckta arbeten och egna teckningar. (Se Sv. Bot. Tidskr., 1930, sid. 26.)

Fil. kand. S. Erlandsson refererade Rabenhorsts Kryptogamenflora, Bd. VII, F. Hustedt, Die Kiesenalgen, Hefte 1—3.

Den 3 december.

Fil. kand. J. A. Nannfeldt höll föredrag om

Några nya synpunkter på ascomyceternas system.

Föredr. refererade i korthet de undersökningar av v. Höhnel, H. Sydow, Theissen, Petrak o. a., som lett till uppställandet av gruppen *Pseudosphaeriales*, och de försök, som gjorts, att från denna grupp härleda såväl pyrenomyceterna som discomyceterna. Man har nämligen velat antaga, att det intertheciala stromat hos *Pseudosphaeriales* genom reduktion skulle kunna ge upphov till pyrenomyceternas och discomyceternas parafyser. I anslutning till ett nyligen utkommet arbete av J. H. Miller, »Biological Studies in the Sphaeriales» (Mycologia, Vol. XX, 1928), sökte föredr. uppvisa omöjligheten av denna utveckling.

Föredr. ville helt lämna *Hemiascomycetes* och bland *Euascomycetes* ordningen *Laboulbeniales* ur räkningen såsom avvikande typer utan närmare

anknytning till några andra ascomycetgrupper. Bland de övriga kunna efter fruktkropparnas utveckling urskiljas i huvudsak tre typer.

Den första representeras av *Plectascales*. Här omväxas de ascogena hyferna och asci ± luckert av skyddande sterila hyfer. En dylik fruktkropp saknar alltså mynning, och i dess inre ligga asci regellöst spridda.

Den andra representeras av bl. a. *Pseudosphaeriales*. Här anlägges först ett ± kompakt stroma, i vilket ascogon (och ev. antheridier) anläggas, och de ascogena hyferna och asci dels undanträngа, dels resorbera stromavävnaden.

Den tredje, slutligen, representeras av discomyceterna och de verkliga pyrenomyceterna. Ascogon och antheridier anläggas än fritt, än inuti ett stroma. På ett eller annat vis (åtminstone oftast från ascogonets bärcell) bildas en hyfvävnad, som ± omsluter de ascogena hyferna och från vilken parafyserna utväxa. Mellan dessa växa sedan asci in. Det eventuellt befintliga stromat genombrytes, och hymeniet antar antingen som hos discomyceterna skålform eller som hos pyrenomyceterna bekläder insidan av en sfär, som mynnar med en trång por.

Mellan den första typen och de bägge senare synas övergångsformer finnas, men däremot kunna dylika ej tänkas mellan den andra och den tredje. De bägge senare ville föredr. betrakta som naturliga systematiska enheter, ehuru deras gräns mot *Plectascales* ännu vore föga känd. Han ville för dem införa namnen *Ascoloculares*, resp. *Ascohymeniales* med tanke på att asci ligga i loculi, resp. tillsammans med parafyserna bilda ett hymenium.

De i Gäumann-Dodge, »Comparative Morphology of Fungi», upptagna grupperna skulle i huvudsak fördela sig på följande sätt efter det nya systemet:

Till *Ascoloculares* höra *Perisporiales*, *Myriangiales*, av *Sphaeriales* delar av familjerna *Sordariaceae* och *Sphaeriaceae*, familjerna *Cucurbitariaceae*, *Coryneliaceae*, *Amphisphaeriaceae* och *Mycosphaerellaceae*, delar av *Dothideales*, av *Hysteriales* åtminstone familjen *Hysteriaceae*, *Hemisphaeriales* och möjligen delar av *Tuberales*.

Till *Ascohymeniales* höra *Hypocreales*, av *Sphaeriales* huvudparten av *Sordariaceae*, delar av *Sphaeriaceae*, familjerna *Gnomoniaceae*, *Diatrypaceae*, *Diaporthaceae* och *Xylariaceae* samt möjligen familjen *Ceratostomataceae*, delar av *Dothideales*, av *Hysteriales* åtminstone familjerna *Hypodermataceae*, *Ostropaceae* och *Acrospermaceae*, *Phacidiales*, *Pezizales* och delar av *Tuberales* samt *Discolichenes* och troligen huvudparten av *Pyrenolichenes*.

Då emellertid alla det traditionella systemets enheter äro synnerligen heterogena, anträffas inom alla grupper arter, vilka äro av helt annan släktskap än gruppen i övrigt.

De traditionella grupperna *Pyrenomycetes*, *Discomycetes* och *Tuberales* ansåg föredr. vara mera biologiska typer än systematiska enheter. *Hypodermataceae*, *Ostropaceae*, *Phacidiales*, *Pezizales*, *Discolichenes* och de ascohymeniala delarna av *Tuberales* vore emellertid en naturlig enhet, som allt framgent kunde betecknas som *Discomycetes*. *Pyrenomycetes* omfattade flera utvecklingsserier, av vilka åtskilliga upptäckts och definie-

rats av v. Höhnel och Petrak m. fl., men där åtskilliga säkerligen ännu vore att upptäcka. En från alla de övriga *Ascohymeniales* genom saknaden av perithecievägg och parafyser avvikande typ är *Clavicipiteae* bland *Hypocreales*. (Autoreferat.)

Den 10 december.

Företogs en exkursion till Experimentalfältet, varest direktör G. Lind och professor S. Odén demonstrerade elektrohortikulturella anläggningar och försök.

Botaniska Sällskapet i Stockholm.

Den 3 februari.

Professor Rolf Nordhagen höll ett med talrika ljusbilder illustrerat föredrag om »Vegetationsbilder från Marocko och Atlasbergen».

Den 23 februari.

Fil. lic. E. Almquist höll ett inledningsföredrag till diskussion angående en ny upplaga av »Stockholmstraktens växter».
(Se Sv. Bot. Tidskr., 1929, sid. 273.)

Den 21 mars.

Ingenjör O. Cyrén höll föredrag om »*Eucalyptus*-odlingarna i Portugal och deras användning». Ett stort antal ljusbilder och ved- samt cellulosapreparat demonstrerades.

Professor O. Rosenberg demonstrerade ett antal mikroskopiska preparat belysande mossornas anatomi och apogama växters embryologi.

Den 16 maj.

Kandidat Th. Arwidsson höll ett av ljusbilder beledsagat föredrag »Om *Erica tetralix* i Södermanland och Östergötland».

Lektor J. R. Jungner höll föredrag om »Stockholmstraktens *Mentha*-arter». I samband härmed demonstrerades ett rikligt material av de behandlade arterna.

Den 1 november.

Jägmästare E. Wibeck höll föredrag om »Tallens och granens kottsättning och fröbeskaffenhet. En orientering över några för svenskt skogsbruk betydelsefulla biologiska problem.» Föredraget beledsagades av ljusbilder.

Kandidat I. Fröman redogjorde för de exkursioner, som han under sommaren 1929 företagit genom nordöstra Södertörn. Efter föredraget följde växtförevisning.

Den 23 november.

Läroverksadjunkten T. Vestergren höll ett föredrag betitlat »Bidrag till svensk floristik». Ett flertal nyutbrutna och nykombinerade arter demonstrerades.

Vid förrättat styrelseval utsågos till ordförande professor O. Rosenberg, till vice ordförande professor R. Fries, till skattmästare fondmäklare A. L. Segerström och till sekreterare amanuens E. Söderberg.

Botaniska Föreningen i Göteborg.

Sammanträden.

Den 25 januari.

Herr T. Borgvall demonstrerade den av honom vid Jerkholmen i Askims sn upptäckta, hittills okända släktbastarden *Ammophila arenaria*×*Calamagrostis arundinacea*.

Herr R. Ohlsén förevisade ett stort antal av honom i Stockholms skärgård och på Öland insamlade växter.

Den 22 februari.

Professor C. Skottsberg redogjorde för vegetationsförhållandena i Tjeckoslovakien och Polen enligt iakttagelser under den Internationella växtgeografiska exkursionen 1928. Ljusbilder och pressade växter demonstrerades.

Den 15 mars.

(Gemensamt med Biologiska Föreningen.)

Ingenjör O. Cyrén höll ett av preparat och ljusbilder illustrerat föredrag över ämnet »Genom Anatolien från Bithyniska Olympen till Erdschias Dagh».

Den 25 april.

Lektor R. Sterner höll föredrag om sina botaniska undersökningar i Kalmar sunds skärgård, särskilt kring Påskallavik. Fotografier och pressade växter visades.

Den 31 maj.

Herr R. Ohlsén föredrog om sina undersökningar inom sl. *Taraxacum*, särskilt i Göteborgstrakten, och förevisade ett 70-tal arter i pressat och ett 20-tal i levande tillstånd.

Den 27 september.

Herr R. Ohlsén redogjorde för de undersökningar han med understöd av föreningen företagit i den hittills föga kända Lane-Ryrs sn i Bohuslän. De intressantare fynden belades med pressat material och illustrerades av utbredningskartor.

Amanuensen C. Blom förevisade den mediterrana *Agropyrum panormitanum* (Bertol.) Parl., en för Sverige ny adventivväxt, som nyss inkommit till Göteborg, säkerligen med emballage till sydfrukter.

Den 25 oktober.

Föreningen beslöt att införa ständigt ledamotskap. Avgiften sattes till 75 kronor. Sålunda inflytande medel skulle avsättas till en särskild fond.

Den 4 maj.

Doktor Ernst Häyrén föredrog om alluvialvegetationen vid Petsamonjoki, dess sammansättning och successionsförhållanden.

Framlades 4:de volymen av Sällskapets Memoranda, omfattande verksamhetsåret 1927—1928.

Doktor Runar Forsius förevisade talrika av honom mestadels på Åland insamlade, av insekter förorsakade gallbildningar.

Den 13 maj.

Doktor Ernst Häyrén förevisade av honom i Petsamo, särskilt på Fiskarhalvön insamlade *Salix*-former, som blivit bestämda av doktor Björn Floderus i Sverige: *Salix glandulifera*-bastarder, *S. phylicifolia* f. *irrigua* Flod., *S. stipulifera* Flod. i en del bastarder, *S. myrsinites*-bastarder och bastarder med *S. herbacea*. — Inlämnande en uppsats: »Zwei Notizen über das Meereseis und die Algen. 1). Hormidium flaccidum im Schmelzwasser auf dem Meereseise bei Helsingfors. 2). Über die Verbreitung der Algen mittels des Meereseises.» — Förevisade en trädgårdstulpan med groddknopp i nedersta bladvecket, medan blommor icke utbildats.

Doktor Carl Cedercreutz anmälde en uppsats: »Süsswasseralgen aus Petsamo», vari redogöres framför allt för den alpina regionens sötvattensalgflora.

Den 5 oktober.

Doktor Carl Cedercreutz förevisade exemplar av *Potamogeton zosterifolius* Schum., som han insamlat i Toböle träsk i Saltvik socken på Åland, samt meddelade en översikt av artens utbredning inom Finland.

Student Sven Nordberg hade insänt ett meddelande om en ny fyndort på Åland för *Allium ursinum* (Saltvik).

Den 2 november.

Magister Johan Björkstén föredrog: »Orientering i några biokemiska problem, samt ett bidrag till metodiken för undersökning av kvävehaltiga ämnens syntes hos högre växter». Föredragaren har genom vakuuminfiltrationsmetoden och genom arbete med kvävehungriga växtdelar kunnat undersöka förhållandena vid äggvitesyntesen in vivo på ett sätt, som ej tidigare varit möjligt. Vid arbete med denna metodik elimineras de felkällor, som härröra från de undersökta ämnenas upptagande genom rötterna. Som viktigaste felkälla kvarstår, att cellerna ej momentant upptaga ämnen, som erbjudas dem i en infiltrerad lösning. Den erforderliga tiden torde dock vara rätt kort. Kvävehungriga cellers permeabilitet för kvävehaltiga ämnen torde vara stegrad. Till denna uppfattning har föredr. kommit särskilt på grund av försök med alkylsubstituerade karbamider, vilka kemiskt böra vara tämligen likvärda, men vilkas permeationsförmåga i hög grad varierar. För att erhålla nödigt växtmaterial för sina arbeten har föredragaren utarbetat en ny kulturmetod, som möjliggör bekväm odling av groddplantor i bestämda närlösningar, i synnerligen stor skala (jfr. Soc. Scient. Fennica Comm. Biol., vol. 3, N:o 7).

Docent Runar Collander redogjorde för en av honom utförd undersökning av cellsaftens sammansättning hos *Chara ceratophylla* Wallr. samt

refererade i anslutning härtill några av andra forskare utförda undersökningar angående cellsaftens sammansättning hos submerst levande vattenväxter.

Tandläkare M. Poulanne demonstrerade: 1. *Puccinellia phryganodes*, som sommaren 1929 insamlades av skolrådet dr. U. Saxén vid mynningen av Siikajoki i mellersta Österbotten; 2. *Taraxacum balticum* från Borgå skärgård i Nyland, likaledes insamlad av dr. U. Saxén.

Doktor U. Saxén demonstrerade några bastarder mellan å ena sidan *Carex salina*, å den andra *C. Goodenowii*, *C. *juncella* eller *C. aquatilis*, vilka han sommaren 1929 insamlat i närheten av mynningen av Siikajoki i mellersta Österbotten. Härvid framhölls bl. a., att hos *C. salina*, likasom hos *C. maritima*, själva nöten är försedd med en tydlig fåra, en karaktär som går igen hos bastarderna och underlättar dessas igenkännande.

Lektor A. Ulvinen anmälde: 1. *Viola uliginosa*, som han sommaren 1929 insamlat i Kouvola i Savonia australis (östligaste fyndplats i Finland); 2. *Asperula odorata*, av honom insamlad i Kaipiais i Karelia australis samma sommar.

Magister Bror Pettersson inlämnade tvenne uppsatser: 1. »Ferns and Flowering Plants on Erratic Blocks with special Reference to their Modes of Dispersal.» På flyttblock i närheten av Helsingfors iakttogos 43 högre växtarter, och en viss korrelation synes råda mellan diasporernas beskaffenhet och flyttblockens höjd över den omgivande terrängen. De växter, vilkas diasporer sakna särskilda spridningsmedel, uppvisade ett frekvensmaximum för den lägsta nivån med ett kontinuerligt avtagande upp till 2 meter, utöver vilken höjd inga accidentella arter anträffats. De zookora arterna förekommo rikligast på 1,5—2 m nivåerna, medan anemokorerna visade en typisk stegring med blockets tilltagande höjd. — 2. »Florula of Tree-stumps». Vid undersökning av ett halft tusental stubbar av olika ålder och olika trädslag uppgick totala antalet kärlväxter på stubbytorna till 35. Tallstubbarna härbärgerade endast 8 arter, granstubbarna 13, alstubbarna 15 och björkstubbarna 23 arter.

Den 7 december.

Magister H. Roivainen föredrog om regnskogarna på Eldslandet samt demonstrerade talrika herbarieväxter från ifrågavarande trakter.

I tryck förelåg 55:te tomen av Acta Societatis pro Fauna et Flora Fennica, tillägnad professor Fredr. Elfving. Ordföranden frambar Sällskapets tacksamhet för alla de stora tjänster professor Elfving gjort Sällskapet.

Docent Runar Collander anmälde till publikation: »Permeabilitätsstudien an Chara ceratophylla I. Die normale Zusammensetzung des Zellsaftes».

Doktor Carl Cedercreutz redogjorde för sina undersökningar över algvegetationen i träsken på Åland.

Lektor Ole Eklund anmälde *Taraxaca* från Åbo skärgård, däribland en ny art, *T. suprasalinum* n. sp., vidare *T. glaucinum* Dahlst., ny för landet, samt de för Regio aboënsis nya *T. concolor* och *T. stenoschistum*. Till publikation anmäldes: »Beitrag zur Taraxacum-Flora des Schärenmeeres SW-Finnlands».

10†—3016.

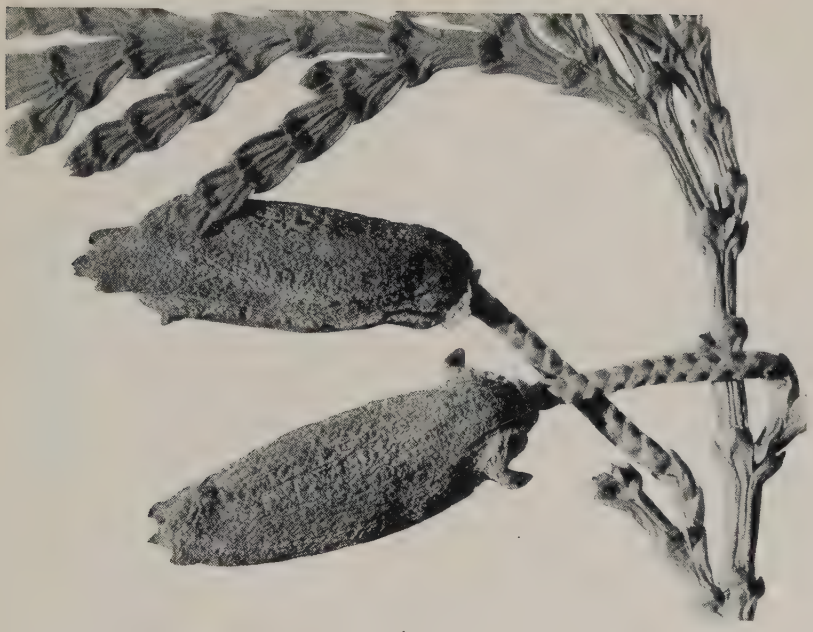
NOTISER.

Utmärkelser åt professor R. Sernander. — Kungl. Fysiografiska Sällskapet i Lund överlämnade vid sin årshögtid den 2 december 1929 till prof. R. Sernander sin medalj i guld »till professor Bengt Jönssons minne» för hans synnerligen förtjänstfulla arbete »Zur Morphologie und Biologie der Diasporen». Svenska Sällskapet för antropologi och geografi har den 21 februari 1930 beslutat tilldela prof. Sernander sin Wahlbergsmedalj i guld för det utmärkta sätt, varpå han gagnat den geografiska forskningen genom sina studier över den svenska växtvärldens utveckling efter istiden, genom sin entusiasmerande lärargärning och genom sitt arbete för det svenska naturskyddet. Medaljen kommer att överlämnas vid Vega-jubileet den 24 april 1930.

Doktorsdisputation. — För vinnande av filosofisk doktorsgrad försvarade fil. lic. Gunnar Booberg å Växtbiologiska Institutionen i Uppsala den 15 mars 1930 en avhandling »Gisselåsmyren. En växtsociologisk och utvecklingshistorisk monografi över en jämtländsk myr».

Bresadolas svampherbarium. — Den bekante mykologen Lars Romell förvärvade på sin tid abbé Bresadolas stora och synnerligen värdefulla svampherbarium. Detta befinner sig numera i Riksmuseums ägo, som beretts tillfälle att inlösa detsamma genom mecenatmedel. Köpesumman uppgick till 18 000 kronor.

Stipendier. — Ett Rockefellerstipendium har tilldelats fil. dr. G. Erdtman, Stockholm, för 12 månaders studier vid University of Alberta, Edmonton rörande vegetationens senkvartära utvecklingshistoria i delar av Canada. Ur Längmanska Kulturfonden ha utdelats följande anslag: till fil. dr. G. Erdtman 300 kr. för utarbetande av kartor över bokens nutida utbredning i Europa samt 300 kr. för tryckning av »Literature on Pollen-statistics published in the years 1927—1929» och »Notes on the geo-biological Development of Europe during the late Quarternary Epoch»; till assistenten, fil. lic. R. Florin, Stockholm, 2 000 kr. för tryckning av första delen av ett arbete med titeln »Zur Stammesgeschichte der Coniferales und Cordaitales»; till prof. N. Heribert Nilsson, Alnarp, 1 000 kr. för undersökningar över artbildning m. m. inom släktet *Salix;* till lektor E. Teiling, Strängnäs, 1 000 kr. för undersökning av Sveriges fytoplanktonflora och -vegetation. Ur Lennanderska Fonden har lektor F. Hård av Segerstad, Karlstad, erhållit 2 400 kr. för fortsatta växtgeografiska undersökningar inom nordvästra delen av Sveriges ekregion.



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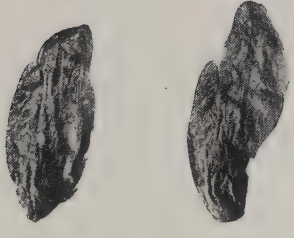

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Svensk Botanisk Tidskrift. 1930. Bd. 24, H. 2.

GROWTH AND ABSORPTION BY OATS IN RELATION TO VARYING CONCENTRATIONS OF CALCIUM AND SODIUM IN THE NUTRIENT SOLUTION.

BY

CARL PHILIPSON.

I. FORMULATION OF PROBLEMS.

A paper by the author, published in 1924 (Philipson, 1924) contains a statement that the antagonistic effect between calcium and sodium, in the widest sense of the word, was exercised in solution cultures simultaneously with the nutritive effect, as far as the production of dry matter by Svalöf's Dala-oats during a period of two months was concerned, the sum total of the varying concentrations of calcium and sodium being kept constant. The average of dry weights actually found plotted against the ratio between the ions, as the method of Osterhout (1922, p. 125) describes, produced a curve with two minima, of which at least one was well-marked, and two well-marked maxima.

The problem for this investigation is to establish this curve and possibly get the connection to causally related phenomena. The dry material from this experiment would have to be analysed chemically, in order to ascertain whether the absorption of any substances may involve a part of the causality which leads up to the curve. For purposes of comparison analyses were made of the dry material from another experiment, the production of dry matter being recorded in the aforesaid paper. The substances determined in the analysis were calcium and nitrogen, the former

being one of the varied constituents of the nutrient solution, the latter being known as one of the most essential for plant growth.

Furthermore, the dry weight of ripened seeds and tops of the plants were determined in an investigation with a greater number of plants. In the experiments the calcium and sodium concentrations of the solution were varied within wider limits than those of previous cultures. Thus, the curves of dry weight against the variation of either of the ions, as well as against the ratio between them could be plotted. Finally, the connections with these results from cultures for the whole, or nearly whole, vegetation period with the growth and absorption of calcium during the first three weeks of growth was to be established.

Osterhout (1922, p. 214, 1915, 1916 and 1917, cf. however Le Clerc and Breazeale, 1920) and others (e. g. Mevius, 1927) have shown a relation between the antagonistic phenomena and permeability. A test to establish such a connection for the case concerned through investigation of physical-chemical properties of phosphatide substances, which according to Hansteen Cranner (1922) exercise a paramount influence upon the mechanism of permeability, has yet failed to give results easy of interpretation, and therefore this test will be published later.

Thus this paper will chiefly deal with the production of dry weight and the amount of calcium and nitrogen actually absorbed in relation to varying concentrations of calcium and sodium in different stages of growth, only considering the mechanism of permeability and other factors involved in the causality of the phenomena in so far as a review of the literature on the subject is concerned.

This limitation of the problem has been necessary, because the entire sequence of the causalities, which lead up to these relations, involves many factors, the influence of which must be elucidated with many more experiments, before a discussion of them can lead to more than an accumulation of assumptions and hypotheses.

* * *

It is the author's pleasant duty to thank all persons who in one way or another have facilitated his work, in the first place Professor O. Rosenberg who as his teacher has animated his interest in General Botany. The experiment 1925 B with sugar

beets was started at the suggestion of Doctor O. Arrhenius who also gave facilities for carrying out several of the experiments, for which the author wishes to express his appreciation. The courtesy of Professor A. Westergren enabled the chemical analyses to be carried out in the Analytical Laboratory of this University and for this the author wishes to express his gratitude.

II. CULTURE METHODS.

The water culture method has been used in all experiments except that with sugar beets in sand culture described in IX. This method was used already by Woodward, in 1699 (quoted by Pfeffer, 1897 and Tottingham, 1914). Pfeiffer (1918) did not know of Woodward's investigation, he claims du Hamel, 1765, as the first to employ it (according to a quotation by Knop). It occurred at intervals in experiments during the eighteenth and nineteenth century. The knowledge of plant nutrition acquired by experiments carried out by de Saussure, Sprengel and Liebig, was mainly gained by other methods (cit. from Pfeiffer, 1918). It was first in a work by Sachs in 1858 (quoted by Pfeffer, 1897) that the water culture method was given its prominent place in the investigation of plant growth.

Through this method a better control of the physical-chemical variation of the culture media is made possible, in comparison with soil and sand culture methods. This advantage will be more clearly emphasized either by making successive chemical analyses of the media or by continuously renewing the solution. This statement is made by Hoagland (1919, p. 105) in an account of experiments carried out according to the former method with successive analyses. Nobbe was the first to suggest the method of continuous renewal of solution, and also to carry out an experiment with this method (1866, p. 342). This method has later been used by different American investigators (e. g. Allison & Shive, 1923). Tottingham (1914) acknowledges Nobbe's priority (cf. also Trelease and Livingston, 1922, Trelease and Free, 1917).

1. **Control of the Rate of Renewal.**

The method with continuous renewal has been used throughout this investigation. The specialized arrangement for attaining a

constant rate of flow has been altered from experiment to experiment. These arrangements will be accounted for separately in each experiment. In order to investigate whether the rate was rapid enough for maintaining constant concentration of the solutions, a rough estimate was made in the course of each experiment of the hydrogen ion concentration according to GILLESPIE (CLARK, 1928, p. 122) with methyl red. The difference between the estimated acidity and the original value was always less than $\pm$ 0.2 in P_H. In some of the experiments the calcium concentration of the solution was determined once during the experiment and found to differ from the intended value by less than $\pm$ 3 per cent of the value.

2. Plant Material.

The plant investigated has always been Svalöf's Dala-oats, 0924. This strain was chosen, because its P_H-optimum (communicated by ARRHENIUS), is about 5. At this P_H the precipitation of the insoluble salts is finely dispersed and therefore a regular distribution of the salts in the solution is maintained. Moreover, more alkaline solutions form a hindrance in the passage through the tube connections with the storage vessels. A selection within this strain was only made in the 1923 experiment by grading the seeds, the number of plants in all other experiments was large enough not to necessitate such a selection.

The variation of the seeds has been recorded for the 1929 experiment, as far as dry weights and calcium contents are concerned (p. 195). The estimation of this variation was omitted from the other experiments, because the time during which the plants were allowed to grow in these experiments was long enough to render such high values of dry weights and mineral constituents absorbed, as to make the variation in the small dry weights and mineral constituents of the seeds entirely negligible.

3. Conditions under which the Experiments have been carried out.

The 1922 experiment was carried out in the open air, those of 1924, 1925 and 1926 under a glass roof, and those of 1923 and 1929 in greenhouses. The solutions were daily aërated in 1922, but the aëration was omitted from 1923 and onwards. The coin-

cidence of three of the later experiments with the general features of the 1922 results indicate that aëration does not affect the relative action of the solutions. The actual growth may, however, very well be influenced, as pointed out by Allison and Shive (1923) (cf. also Hall, Brenchley and Underwood, 1923).

4. Nutrient Solutions.

The solution used in all experiments contained 0.14 gr/l. sol. $MgSO_4 \cdot 7\ H_2O$, 0.3 gr/l. sol. KNO_3, 0.04 gr/l. sol. $FeCl_3$ (or $FeSO_4$ in eqvivalent amount in the later experiments, the precipitation of insoluble iron salts did not occur so early, when $FeSO_4$ was used) and 0.1 gr/l. sol. ($KH_2PO_4 + K_2HPO_4$). (Four times the concentrations given by Olsen, 1921.) The proportions between the primary and secondary phosphates were chosen in such a way as to make the acidity of the whole solution 4.7 ± 0.2 in 1922 and 1923, and 5.0 ± 0.2 in the other years. (According to Tottingham and Rankin (1922) a high degree of acidity was not so well tolerated by wheat in continuously as in intermittently renewed solutions.) This proportion has to be varied very slightly on account of the variation of the concentration of carbon dioxide in the distilled water. This variation is certainly small enough to be disregarded in the comparison of the results. To this solution were added varying amounts of calcium and sodium chloride. All chemicals were of the very best quality obtainable.

The highest concentration of calcium chloride used (except 1923 B) was 0.2 gr/l. sol. $CaCl_2 \cdot 6\ H_2O$. The weight of the calcium in each litre of this solution or 0.0365 gr/l. sol. has been taken as a unit and given a relative value of 10. The same concentration according to the weight of sodium is also called 10. Each solution can thus be defined in terms of its coordinates in an xy-plane where the calcium and sodium concentration in its relative values have been plotted as respectively abscissæ and ordinates. By omitting the comma and the paranthesis of the usual signification (x, y) a brief designation of the solutions has been reached. The symbol 64, for example, in this paper expresses a solution with all other constituents in concentrations given above, and with calcium and sodium in concentration 6 and 4 in the above defined relative values.

In figure 1 all points have been plotted which symbolize the solutions investigated (except those of 1923 B). From this figure the following three systems of parallel lines are used for comparing the results. Each single line of the first system to which the ordinate axis belongs represents a series of solutions with

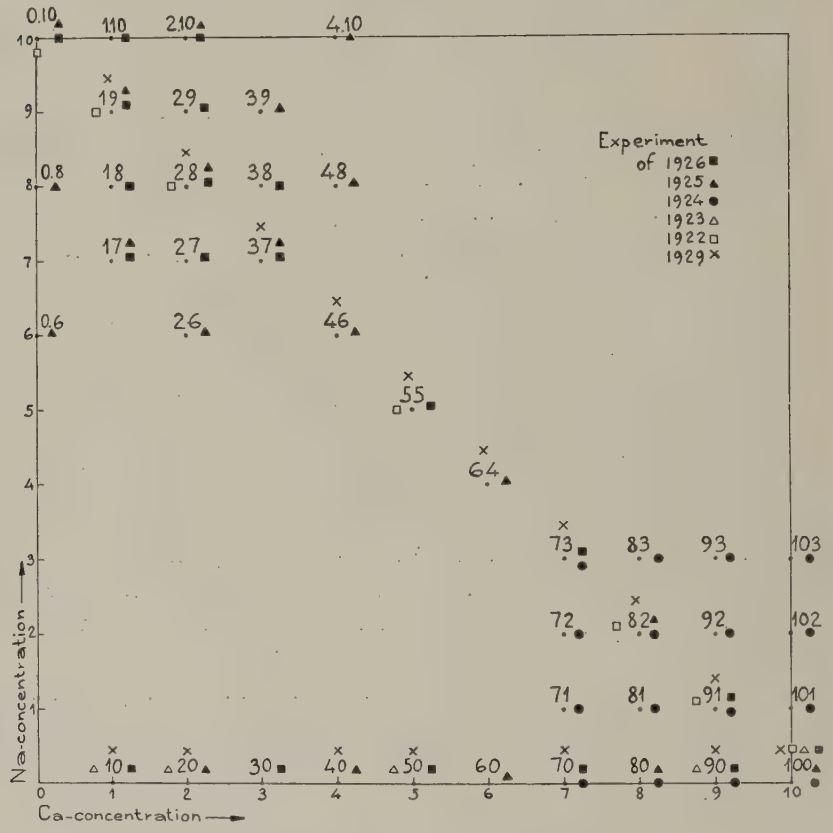

Fig. 1. Graph showing the concentrations of calcium and sodium in the solutions of all experiments, except that of 1923 B.

constant calcium concentration. Each single line of the second system to which the abscissa axis belongs represents a series of solutions with constant sodium concentration and, finally, the system of lines parallel to the line through points 010 and 100 summarizes the series, each one containing calcium and sodium in concentrations, whose sum total is constant throughout each series. The results of the growth either in terms of dry matter

production or absorption will then be plotted as ordinates of curves, the x-axis representing one of these lines. The symbol of a solution will also be used as representing a point of such a curve as expresses the growth in the solution, which is signified by the symbol in question.

Behind this system of arranging the solutions an assumption may be concealed as to the importance of the concentration expressed by weight. This was emphasized already in the 1924 paper by the author (p. 346) and has been subjected to criticism by Mevius (1925). The author of this paper does not consider that any investigation known to him supplies any intelligible conception of the essential relation between any unit of concentration and growth. In all experiments in which only one factor has been varied, and the relation between this factor and growth has been plotted as a curve, a use of the normality or the weight concentration makes no other difference to the curve except that of changing the scale of the abscissæ. Thus a certain relation must be simple if normality be taken as a unit of the concentration, if this relation is simple when the concentration is expressed by weight unit. From such experiments nothing in favour of one or other of the units can be established.

From experiments in which more than one factor varied the author quotes the following investigations. Hansteen Cranner (1910) used normality and Osterhout (1922) molarity as units. Both obtain "antagonism curves", i. e. curves containing at least one optimum, if the growth is plotted against an abscissa corresponding to the line of the system mentioned above, which passes through points 010 and 100, but with other units. The results of these investigations thus give a more or less complicated relation between growth and normality respectively molarity of the solutions. It cannot be predicted whether the relation would be more or less essential if the experiments had been arranged on the basis of weights as units. As shall be further discussed hereinafter, no theory of the mechanism of salt intake and antagonism as yet given is capable of explaining the multitude and complexity of phenomena under consideration; no suggestion as to the relevancy of weight, normality or molarity can be looked for in such a theory. Until a theory is found which gives credit to all facts established by experiments, the problem of the correct unit for the concentration must remain unsolved. And until this is

done, it will be a matter of convenience as to which unit is selected.

In fact, if the aforesaid xy-plane is combined with a z-axis normal to the plane, and if the growth is plotted upon this axis, a solid figure should result, which, constructed on other units of concentration, would only be shortened in one dimension, without altering its essential features. In order to facilitate the description and interpretation of these results, we shall take a series of sections of this figure, the z-axis representing the growth in the series of solutions mentioned above. The method of taking these sections has a close relation to the unit chosen. If the normality could be proved to be the correct unit, the sections chosen, by taking weight as unit, should only change their angles to the xz-plane but would nevertheless be parallel to each other. Thus the method of arranging the sections will make for easy comprehension of the solid figure in question even if the assumption of weight as the correct unit of concentration were not permissible.

Moreover, as the weight is the common unit of dry matter production, the choice of any other unit will have to be proved, as was stated by the author in 1924 (p. 346). To this Mevius objects that since there is no simple relation between the absorption of mineral constituents and the production of dry matter, there is no reason for expressing dry matter production and concentration in the same units. But if a complicated relation is proved for dry matter production and absorption, expressed in terms of equivalents, a complicated relation exists also if concentration is expressed in terms of weight. Thus no conclusion of the relevancy of one or the other unit can be drawn from this relation.

Finally, the method of expressing concentration in normality, defined by the chemists, was principally connected with the fact that a multitude of physical-chemical phenomena, e. g. the osmotic pressure, were considered to have a close relation to the normality of the solution. Even here later investigations have demonstrated essential limitations to this thesis, as was propounded by Findlay (1913) and Bjerrum (1920) and many others (cf. also Fitting, 1917). In plant nutrition, however, the nature of the ion is of paramount importance, the membranes through which the intake of the ions takes place being influenced by the nature of the penetrating ions, as has been pointed out by Osterhout

(l. c.) and others. HOAGLAND also emphasizes (1919) that the osmotic pressure, i. e. approximately the direct effect of the sum of the equivalents present upon a perfect semipermeable membrane, is not the significant definition of a certain solution in its action upon plant growth (1919, p. 112). He has also stated his results in p. p. mill. of the solution. The author therefore maintains that MEVIUS' criticism (l. c.) does not stand the test.

5. Germination and Planting.

For germination the seeds were placed on filter-paper and in saw-dust. The seedlings were planted by means of cotton wool in paper-plates.

6. Methods of Preventing Contamination.

These plates were paraffined in all experiments and in cases in which plants were allowed to grow to maturity the plates were guarded against decay by a shellack solution, which was applied before paraffining. In the 1923 experiment, however, paraffined corks were used instead of the paper-plates. The plates used in the 1929 experiment rested directly on the lid, described in connection with the apparatus of continuous renewal, used then (see below p. 194).

The plates were attached to the culture jars, which in the outdoor experiments (of 1922, 1924, 1925 and 1926) were of earthenware, with acidproof glazing. This attachment was attained either through a paraffin edge melted directly to the lid or a cover of rubber cloth, washed out in hydrochloric acid and distilled water, and fastened to the lid with a solution of celluloid in chemically pure aceton, which was allowed to evaporate. The projecting edges of the cloth, finally, were tied to the jars; this was done to prevent any contamination from entering into the culture solution.

The glass bottles used in the 1923 experiment were steamed and the culture jars as well as all vessels, tubing and rubber connections, which came into contact with the solutions, were allowed to soak in tap-water for some time and afterwards rinsed out with distilled water. The distilled water used for the solutions was tested in each supply for heavy metals, and these tests were always negative. Finally, it must be remembered that the method of continuous renewal diminishes the influence of chance

impurities, as the flow of solution gradually diminishes the concentration of the foreign substance, while in the case of intermittent renewal, the foreign substance is allowed to influence the growth until the solution is changed.

7. Climatic Conditions and Diseases.

The climatic conditions could not be checked. In the outdoor experiments the plants seemed to grow very well. The occurrence of infections was noted especially in 1924 when a severe infection by rust attacked all the cultures. Attacks by green aphides were checked by sprinkling with nicotine sulphate. A few plants were covered at the base of the stem with green algae, which has been considered when treating the results (see below p. 165). Finally the physiological disease, mentioned in Philipson, 1924, called grey-spot disease, which seemed to be involved in the problem studied, will be discussed here below as to its occurrence in the cultures (see part VIII). The plants of 1923 and 1929 experiments, both in greenhouses, seemed to suffer more or less from too high a temperature and too low an intensity of light, and were consequently to a certain degree etiolated.

These limitations, however, of the normality in growth of plants, which are grown under conditions so different from those of their natural habitats, are surely not unusual in experiments of this kind. It must be emphasized, however, that in spite of these deviations from normal growth, and in spite of the wide range within which the conditions in question varied from experiment to experiment, the results from all have a striking similarity in all relative comparisons made below.

The discussion afforded on the comparison of different experiments in Philipson, 1924 (compare also Bondorff, 1924, p. 322—323) points to an independance — yet within certain limits — of the influence of several factors. This independance should on the one hand support the comparison between the experiments, — and on the other the relative agreement between the experiments in essential points seems to the author to support this independance. Referring to this latter point of view the comparison between the calcium utilization curves for 1922 and 1929 (see fig. 9 *a*), as well as the antagonism curve of 1922 (see fig. 4 *c*), compared with those of 1924, 1925 and 1926 (see figs. 10 *a*, 11 *a*, 13 *b* and 15 *f*), may be taken into consideration.

8. Sand Cultures.

The method used for the only experiment with sand cultures is described in part IX, together with the results of this experiment.

III. TREATMENT OF CROPS.

1. Estimations.

The material was always dried at the finish at about 104° C. In the outdoor experiments the plants were previously dried in the air at the temperature prevailing in the laboratory; in the greenhouse experiments a previous dessicating process at 60° C. was resorted to. The length of the roots was measured in 1923; the length of each tiller and the number of the tillers was estimated in 1923 and 1924. The occurrence of infections, grey-spot disease, and other irregularities were also noted for each plant. The roots of the ripened plants were always decayed, so that the results of the 1924—1926 experiments could only be recorded in so far as top growth was concerned. The total weight of tops was first fixed; in 1924 and 1926 the plants were threshed by hand, and the seeds dried again and weighed. In 1923 the plants were separated into roots, leaves, stems and heads[1], those of 1929 into roots and tops on harvesting, and the different parts dried and weighed separately. Weighing was carried out with an accuracy of ± 1 in the 3rd figure. The dry weights, either total or those relating to the different parts, have always — with the exception of the brief 1929 experiment — been estimated separately for each plant.

2. Methods of Averaging.

By calculating the averages given in the tables, all plants severely infected by green algae were discarded. In some cases where the culture jars were nearly empty at the time of harvest-

[1] The term "head" is here used for the uppermost part of a flowering or fruiting shoot including the spiculæ, from a point just beneath the lowest branches of the paniculus, in accordance with the usage of Agricultural Scientists e. g. Hewitt 1911.

ing, either through breakage or through the tubes getting choked, all the plants in these jars were discarded. The averages were calculated as the arithmetical mean of all plants, with the exception of 1922 and 1929. In the former experiment the number of plants in each pot was large enough to make the deviation in plant-number due to these discardings negligible. In the latter year the crops which contained only one or two live plants were discarded, the average values were obtained as the arithmetical mean of all harvests actually recorded. (See p. 203, where the method of calculating the mean error is also given.)

3. Calculation of the Mean Error.

In the 1922 and 1923 experiments the formula

$$\mu = \pm \sqrt{\frac{\sum_i (a-a_i)^2}{n(n-1)}}$$

where a is the mean of the values a_i, n the number of a_i and μ the mean error, was applied directly. On calculating the mean errors of 1924—1926 the following evolution of this formula was used:

$$\mu = \pm \sqrt{\frac{\sum_{ij} (a-a_{ij})^2}{\sum_j p_j (\sum_j p_j - 1)}} = \pm \sqrt{\frac{\sum_{ij} (a-a_j+a_j-a_{ij})^2}{\sum_j p_j (\sum_j p_j - 1)}} =$$

$$= \pm \sqrt{\frac{\sum_{ij} (a-a_j)^2 + \sum_{ij} (a_j-a_{ij})^2 + 2 \sum_{ij} (a-a_j)(a_j-a_{ij})}{\sum_j p_j (\sum_j p_j - 1)}}$$

equal to

$$\pm \sqrt{\frac{\sum_j p_j (a-a_j)^2 + \sum_{ij} (a_j-a_{ij})^2}{\sum_j p_j (\sum_j p_j - 1)}}$$

where a is the mean of all plants, a_j that of the plants in jar j, and p_j the number of plants in this jar. This was used as it enabled the simultaneous calculation of the mean errors of each jar.

4. Grinding of Dry Matter.

Before analysis the dry material was ground by hand in an iron coffee mill. In order to discover whether the grinding contaminated the ground substance with iron, some pure NaCl was put through the mill, and a qualitatative test for iron with sulfocyanate was made with negative result.

5. Nitrogen Analysis.

The estimation of the nitrogen percentage was made upon two or more samples of the ground material. The method of analysis was the one described by Andersen and Norman-Jensen (1926). This was followed in all particulars, except that the oxidation bottles could not be closed in the way described, but were instead connected with the ventilation system, besides which the still was slightly modified.

The drop-collector was of a more complicated design, that was rather more efficient, although by the complicated form the risk was run of losing ammonia through absorption in the condensed water. This was avoided by interrupting the distillation at intervals and cooling the distillation bottle, in order to bring about suction of the condensed water back into the bottle. Four distillations were made simultaneously, the cooler-tubes of each apparatus passing through a joint zinc refrigerating case. Then the tubes passed through the doubly perforated rubber stoppers of the receivers. The other hole of the stoppers was supplied with a funnel-shaped tube holding glass beads, moistened with distilled water. These beads were washed twice and the washing water allowed to run direct into the receivers. This arrangement was of course made to unite the possibly escaping ammonia with the amount already absorbed by the hydrochloric acid in the receivers. Later, these funnel-shaped tubes were fitted with absorption tubes for carbon dioxide, as the first analyses made this step necessary. (See below.)

The sodium hydrate for titration was made through filtering a concentrated alcoholic solution into water, which had boiled while being aërated with air, deprived of carbon dioxide, the whole system being entirely closed with absorption tubes. With a mixture of methyl red and methylene blue as indicator titration was carried on until it turned a dirty green.

Table I. **Preliminary Tests of the Method of Nitrogen Analysis.**

Sodium hydrate Nr.	Sodium hydrate Titer	Number of estimations	Averaged percentage	
		Methylacetanilid only (theor. 9.395 % N)		
1	0.0869n	8	9.30 ± 0.02	Without carbon dioxide
2	0.0423n	3	9.32 ± 0.06	absorption tubes in the funnels of the receivers.
		Asparagin only (theor. 18.67 %)		
2	0.0423n	3	18.26 ± 0.02	Without absorption tubes.
4	0.0413n	4	18.58 ± 0.03	With absorption tubes.
5	0.0506n	3	18.52 ± 0.08	» » »
6	0.0461n	3	18.50 ± 0.09	» » »
7	0.0368n	2	18.58 ± 0.03	» » »
8	0.0375n	2	18.45 ± 0.07	Without » »
9	0.0327n	2	18.47 ± 0.06	» » »
10	0.0487n	2	18.62 ± 0.02	With » »
		Sample 100 parallel series 1.		
1	0.0869n	3	2.50 ± 0.01	Without absorption tubes.
2	0.0423n	3	2.46 ± 0.01	» » »
		Sample 100 parallel series 1 + methylacetanilid		
			Percentage of 100 : 1	
1	0.0869n	2	2.51 ± 0.01	The hydrate through the neck of the distillation flask.
1	0.0869n	2	2.52 ± 0.01	The hydrate through the funnel of the distillation flask.

The normality of the different portions of sodium hydrate was first determined against a hydrochloric acid at the laboratory which was controlled in the usual ways. The hydrochloric acid used in the receivers was estimated as to its normality against each portion of sodium hydrate in two ways, directly and after distilling into it a mixture of all reagents without sample. Though the differences representing contaminations of the reagents, were negli-

ible, the latter values have always been used by calculating the results. In order to test the accuracy of the method the following experiments were made. Two substances, known as thoroughly pure from other analyses at the laboratory, methylacetanilid and asparagin, were estimated as to their nitrogen percentage, the results being given in table I.

From this table it was concluded that the difference between the estimated value and that calculated from the composition formula, was never, as far as asparagin was concerned, greater than 1 per cent when absorption tubes were fitted to the funnels of the receivers. This difference must chiefly be due to a systematical error, inasmuch as the temporary ones given in the table are much smaller. The accuracy of the analyses made by ANDERSEN and NORMAN-JENSEN (l. c.) is greater in all cases where the oxidation bottles were closed so as to prevent the evaporation of sulphuric acid. This could not be done in the present investigation, which may explain the error.

From the table can also be seen the advantage of absorption tubes, mentioned above. This was here more advantageous than in the experiments by ANDERSEN and NORMAN-JENSEN, on account of the limited space between the burners and the receivers, which resulted in a higher concentration of carbon dioxide in the air just above the funnels. All analyses of the plants, with the exception of three samples, were made with absorption tubes; for these three samples the estimated values were corrected by the aid of the estimation of asparagin to a comparable state. The addition of the strong solution of sodium hydrate through the neck or the funnel of the distillation flask seems to have exercised no influence. The latter method was found to be more convenient.

The table shows that the errors in the estimation of the dry substance alone are essentially of the same relative influence as those in the estimation of dry substance mixed with methylacetanilid. Finally, the temporary errors were recorded for each sample, which gave the same result of the accuracy of the method as the values given in the table. The temporary errors in the estimation of nitrogen are quite negligible.

The systematical error in the estimation of the plant substance cannot be determined from the figures of table I. It might be possible for the plant substance to contain some nitrogen compound, which would introduce a greater systematical error into the esti-

mation than that of the estimation of asparagin. According to all experience gained it is nevertheless improbable that this will in any high degree influence the accuracy of the estimations. At any rate such a difference between dry substance and methylacetanilid and asparagin, if it did exist, would have to be considered independant of the amount presented for analysis as well as the presence of methylacetanilid, as can be directly concluded from the tests. The regularity of the curves fig. 3 *b* and *f*, p. 183, points also to a relative equality of such an error — if existing — in the different harvests. Finally, it must be remembered that the limits between which this error may possibly vary, are very wide, as the biological variation, given below, is of 10 times greater an order of magnitude than the systematical error of the estimation of asparagin, given above. We may therefore venture to propound that also the systematical errors of the nitrogen estimation of the plants are negligible in comparison with the biological variation.

6. Estimation of Ash Percentage.

The incineration of the dry material was carried out in an electrical furnace, in a current of oxygen in porcelain crucibles. The 1922 and 1923 material was ground, as described, before incineration. The tops and roots from 1929 were incinerated directly without grinding, the ash percentage not being estimated in this experiment. The combustion temperature was very slowly increased, and it was not until the ash had become nearly white that the temperature was raised to 600° C., and left so for half an hour. The crucibles were cooled in a dessicator and weighed. The ash was treated with a few drops of water, which was evaporated. After drying the crucibles were treated in 600° C. and weighed after cooling. This was repeated until the weight was nearly constant. In the 1929 experiment, however, the ash was heated directly with hydrochloric acid and it was only in case of undissolved black particles occurring that the combustion was repeated after evaporation. The preliminary tests with the combustion method are given in table II together with combustion tests over a gas-flame.

A glance at the table will show that the latter method implies serious occasional errors, whilst the method used for the estimations has an occasional error of less than 2 per cent. This is also

Table II. **Preliminary Tests of the Method of Combustion.**

a. Sample 100 parallel series 2. Combustion over gas-flame. Crucibles of Berlin-porcelain without lid.

Combustion 1. 11.9 %
2. 10.7 %
3. 11.2 %
4. 12.8 %

Crucibles of Rosenthal-porcelain without lid.

Combustion 1. 10.5 %
2. 11.3 %
3. 13.2 %

b. Sample 100 parallel series 3. Combustion over gas-flame. Crucibles of Rosenthal-porcelain with lid.

Combustion 1. 11.1 %
2. 10.4 %
3. 13.3 % longer heating 9.5 %
4. 12.7 % » » 9.8 %

c. Sample 100 parallel series 2. Combustion in an electrical furnace up to 600° C. in an oxygen current.

Combustion 1. 13.11 %
2. 13.05 %
3. 13.25 % Average: 13.14 ± 0.06

d. Sample 100 parallel series 3. Combustion in an electrical furnace up to 600° C. in an oxygen current.

Combustion 1. 12.39 %
2. 12.12 %
3. 12.80 % Average: 12.43 ± 0.20

e. Sample 100 parallel series 1. Combustion in an electrical furnace up to 600° C. in an oxygen current.

Combustion 1. 10.18 %
2. 10.05 %
3. 10.30 % Average: 10.18 ± 0.07

f. Mixture of salts (given in table III e). Combustion in an electrical furnace up to 600° C. in an oxygen current.

6 estimations gave 62.4 ± 0.9 mg.
calculated value 63.4 ± 0.2 mg.

supported by the other parallel estimations not recorded in the table. The errors introduced by the gas-flame combustion seem to be due chiefly to the impossibility of controlling temperature, longer heating (table II b, 3—4) causes the evaporation of consider-

able portions of ash. In fact, the weight of the ash could not be made constant when heated over a gas-flame. The systematical error in the combustion of an artificial ash in the electrical furnace was of the same order of magnitude as the occasional error. It seems improbable that the presence of volatile organic substances should introduce any greater systematical error into the estimation of ash. In comparison with the biological variation the errors in the estimation of the ash percentage must thus be considered negligible.

7. Calcium Analysis.

The hydrochloric acid solution of the ash was used for estimating the calcium percentage of the dry substance according to DE WAARD, 1919. (As to the accuracy of the method compare also MYRBÄCK, 1925, p. 199-200 and literature quoted there.) Table III shows the preliminary tests with the method.

The occasional errors of the estimation in the plant substance, given in a, b and c, are less than 2 per cent. This is supported by all other parallel estimations not recorded here. Parts d, e and f represent estimations of pure $CaCl_2$, alone and mixed with different portions of an artificial ash. The treatment throughout is the same as in the case of the plant substance. The accuracy

Table III. **Preliminary Tests of the Method of Calcium Estimation.**

a. Sample 100 parallel series 1. 3 estimations gave 2.81 ± 0.03 ‰
b. » » » » 2. 3 » » 2.48 ± 0.05 ‰
c. » » » » 3. 3 » » 2.97 ± 0.02 ‰
d. 5 cc. of a solution containing 20.16 mg. Ca pr 100 cc. was evaporated, heated in the electrical furnace in a current of oxygen, and the calcium content estimated with de WAARD's method.

2 estimations gave 1.008 ± 0.002 mg. Ca
calculated value 1.008 ± 0.001 mg. Ca.

e. Together with solution of d, 2 cc. of a solution containing 170.5 mg. Na_2SiO_3 pr 100 cc. and 5 cc. of a solution containing 533.0 mg. K_2HPO_4, 27.9 mg. K_2SO_4, 360.0 mg. $MgHPO_4$, 10.3 mg. $FeCl_3$ and 227.5 mg. KNO_3 pr 100 cc. was evaporated, weighed to check the weights of the salts, and treated as a.

6 estimations gave 1.010 ± 0.005 mg. Ca
calculated value 1.008 ± 0.001 mg. Ca.

f. Half the amounts of the other salts mixed with the same amount Ca treated as before.

1 estimation gave 0.999 mg. Ca.

was, in fact, greater than might have been expected from the paper by DE WAARD (l. c.) himself, inasmuch as the deviation between the calculated value was 2 ‰ in e. As it must be assumed that the solution of the vegetable ash will not form any essentially worse conditions for the calcium estimation than those of the »artificial ash», it may be stated that the errors introduced by the method of calcium estimation are negligible in comparison with the biological variation.

8. **Calculations.**

The percentages of nitrogen, calcium and ash in proportion to dry weight thus determined have been treated as follows. First of all the equivalent absolute value was calculated by multiplying the percentage figure with the corresponding dry weight figure. (This calculation was not necessary in the 1929 experiment, where the absolute value was directly determined by analysis, as the whole harvest of each point was used for one estimation.)

For the 1922 experiment the arithmetical means of each set of the three values of each solution were calculated in accordance with the calculation of dry weights, together with the corresponding mean errors. These means and mean errors are given in table IV. The latter represent the biological variation, which is also seen by the differences on comparing the abscissæ in each point of the three curves of each graph at the top of the figure 3.

For the 1923 experiment the estimations were made on three different portions of material, each obtained by mixing two, three or four plants on grinding. The values were then averaged by calculating the weighed mean. This was done in accordance with the calculation of dry weights for this experiment. The mean errors of these weighed means, calculated according to the usual formula and given together with the means in table V, represent the biological variation. The absolute values of the tops and entire plant were obtained as total of the values of the different parts, the percentage being calculated by dividing these totals with the corresponding dry weights, the mean errors being calculated as before. The calculations for the 1929 experiment will be described in part VI.

In order to save space, the graphs are published on the smallest possible scale.

IV. EXPERIMENTS 1922—1923.

1. Arrangement of Cultures.

The continuous renewal of the solution was attained through capillary tubes connected with rubber connections with glass siphons. In the 1922 experiment these siphons were inserted into the storage bottles directly. The storage bottles for this experiment were carboys, holding 40—60 litres. The pressure for producing the flow varied with the decrease of the stock solution. As this variation would affect the rate of the flow, the rubber connections were provided with pinch-cocks, with which the rate of the flow was regulated once a day, which was sufficient by reason of the slight daily variation in height in the large storage carboy. In the 1923 experiment the siphons were inserted into filter flasks which were provided with an outlet. These filter flasks were continuously filled up to their outlet by means of another set of siphons, which entered the storage bottles, the latter being arranged as constant pressure flasks. The flow to the filter flasks was at the beginning of the experiment regulated to be a little faster than the flow to the culture vessels. — Other particulars of the experiments have been described in the author's paper of 1924, except that the rate of the flow was erroneously given in the paper. The correctly calculated rate for 1922 was 14.4 cc.; for 1923 72 cc. per plant and day.

2. Treatment of Material.

In the paper quoted were also recorded the relative dry weights of both experiments, together with the dry weight curves, and a detailed discussion of them was also given. The absolute values are given in tables IV and V, and fig. 2, *e* and *f*.

An estimation of the calcium content, total nitrogen and ash was made some years after the harvest. In order to test whether the stored-up dry material had undergone any changes in the meantime, the dry weight of some samples from each experiment was determined. The material from 1922 had lost 0.4 ± 0.2 per cent of the dry weight and that from 1923 0.2 ± 0.2 per cent. As the mean error was never less than 10 per cent of the dry weight, these losses are negligible.

Table IV. **Experiment of 1922. Averaged values.**

Solution	Number of plants	Dry weight pr plant mg.	Ash content		Nitrogen content		Calcium content	
			% of dry weight	mg. pr plant	% of dry weight	mg. pr plant	‰ of dry weight	mg. pr plant
100	56	883 ± 99	11.9 ±0.9	107 ±19	2.60 ± 0.07	23.1 ± 3.1	2.75 ± 0.14	2.42 ± 0.27
91	36	248 ± 71	6.46±0.32	16.2± 5.3	1.78 ± 0.09	4.5 ± 1.4	2.20 ± 0.09	0.54 ± 0.14
82	47	689 ± 40	11.5 ±0.2	79.3± 5.4	2.52 ± 0.11	17.5 ± 1.7	3.06 ± 0.04	2.11 ± 0.13
55	49	678 ± 73	10.7 ±1.0	73.4±11.9	2.23 ± 0.29	15.5 ± 3.3	2.81 ± 0.22	1.88 ± 0.12
28	56	569 ± 45	10.0 ±0.3	57.3± 5.5	2.38 ± 0.04	13.5 ± 1.1	1.81 ± 0.14	1.02 ± 0.01
19	55	833 ± 74	10.9 ±0.2	90.3± 7.6	2.30 ± 0.19	18.9 ± 1.7	1.49 ± 0.10	1.23 ± 0.05
010	31	140 ± 18	8.61±0.15	12.0± 1.0	2.07 ± 0.05	2.9 ± 0.2	1.56 ± 0.17	0.21 ± 0.01

At least two parallel analyses of each sample were made for each estimation and the average of them was considered as the actual value of the sample. Each sample was weighed out of the entire material from each solution and each series, and this was ground together for the 1922 experiment. The material from 1923 was divided into roots, heads, stems and leaves resp. with the exception of 10 and 20, the leaves and heads of which were ground together. The methods of estimation have been described in the preceding pages. The calcium content curve and the nitrogen content curve, i. e. the absolute amount per plant of the said substances are plotted against the solutions in fig. 2 *c* and *d*, together with the percentage curves. The values of ash content have been plotted together with the dry weights.

3. Relation of Dry Weight to Solutions.

The dry weight stem curve of 1923 tends to a straight line, fig. 2 *f;* the meaning of that relation is not so easily interpreted, as perhaps the points are too few and a curved line may be hidden behind the straight line. Anyhow, no experiments known to the author have established this simple relation, and the material of this experiment is not large enough to permit us to draw a conclusion from this form. In fact, this curve is probably also of the usual shape. The leave-curve and head-curve indicate both a sharper decrease

Table V. **Experiment of**

Solution	Number of plants	Number of tillers pr plant	Length cm.		Dry weight pr plant mg.
100			27.0 ± 1.5	roots	600 ± 58
			110 ± 5	stems	1 824 ± 174
				leaves	1 001 ± 75
				heads	779 ± 98
				top	3 604 ± 175
	9	4.2 ± 0.3		total	4 204 ± 209
90			27.3 ± 1.9	roots	438 ± 60
			93 ± 3	stems	1 463 ± 213
				leaves	601 ± 98
				heads	508 ± 71
				top	2 662 ± 342
	10	4.3 ± 0.3		total	3 099 ± 394
50			28.9 ± 1.3	roots	421 ± 60
			96 ± 6	stems	1 241 ± 141
				leaves	623 ± 58
				heads	447 ± 71
				top	2 311 ± 259
	10	4,3 ± 0.4		total	2 732 ± 317
20			33.9 ± 2.5	roots	227 ± 29
			71 ± 5	stems	724 ± 138
				leaves	386 ± 58
				heads	246 ± 52
				top	1 355 ± 224
	10	3.4 ± 0.2		total	1 582 ± 250
10			41.2 ± 4.2	roots	176 ± 9
			64 ± 3	stems	543 ± 50
				leaves	294 ± 27
				heads	217 ± 24
				top	954 ± 89
	9	3.2 = 0.2		total	1 130 + 93

1923. Averaged Values.

Ash Content		Nitrogen Content		Calcium Content	
% of dry weight	mg. pr plant	% of dry weight	mg. pr plant	‰ of dry weight	mg. pr plant
12.0 ± 0.4	72.0 ± 5.0	1.94 ± 0.14	11.7 ± 1.2	4.64 ± 0.37	2.79 ± 0.29
10.2 ± 0.2	185 ± 19	1.56 ± 0.09	28.6 ± 4.4	1.17 ± 0.14	2.12 ± 0.34
11.8 ± 0.1	118 ± 9	3.13 ± 0.13	31.5 ± 3.4	3.77 ± 0.08	3.78 ± 0.33
5.29 ± 0.73	41.7 ± 8.8	2.30 ± 0.03	17.9 ± 2.1	1.12 ± 0.09	0.88 ± 0.15
9.60 ± 0.24	345 ± 19	2.16 ± 0.08	77.9 ± 7.3	1.87 ± 0.01	6.75 ± 0.51
9.94 ± 0.22	417 ± 23	2.13 ± 0.09	89.5 ± 8.1	2.27 ± 0.07	9.51 ± 0.59
12.2 ± 0.3	53.1 ± 9.4	2.36 ± 0.06	10.5 ± 1.9	3.87 ± 0.17	1.67 ± 0.27
10.4 ± 0.5	150 ± 28	1.81 ± 0.01	26.3 ± 5.4	1.33 ± 0.04	1.92 ± 0.37
11.7 ± 0.2	80.5 ± 15	3.24 ± 0.04	22.4 ± 4.3	4.00 ± 0.18	2.80 ± 0.70
4.56 ± 0.06	23.2 ± 7.0	2.53 ± 0.09	12.9 ± 2.7	1.17 ± 0.13	0.57 ± 0.07
9.62 ± 0.58	254 ± 45	2.32 ± 0.03	61.7 ± 11.1	1.99 ± 0.31	5.28 ± 1.04
9.98 ± 0.36	307 ± 54	2.32 ± 0.03	72.0 ± 13.0	2.25 ± 0.08	6.96 ± 1.30
11.9 ± 1.5	52.6 ± 3.4	1.98 ± 0.25	8.2 ± 1.5	3.84 ± 0.65	1.70 ± 0.62
10.8 ± 0.5	134 ± 18	1.70 ± 0.11	20.8 ± 2.0	0.98 ± 0.13	1.17 ± 0.05
11.9 ± 0.4	73.7 ± 8.6	3.09 ± 0.18	19.3 ± 2.8	3.45 ± 0.12	2.13 ± 0.73
4.50 ± 0.29	20.4 ± 4.6	2.54 ± 0.08	11.3 ± 1.7	0.75 ± 0.02	0.34 ± 0.06
9.89 ± 0.33	229 ± 30	2.24 ± 0.11	51.4 ± 5.6	1.60 ± 0.08	3.64 ± 0.32
10.2 ± 0.3	281 ± 46	2.20 ± 0.13	59.6 ± 7.4	1.96 ± 0.09	5.38 ± 0.92
11.2 ± 0.1	25.5 ± 2.9	3.19 ± 0.21	7.1 ± 0.7	2.33 ± 0.10	0.52 ± 0.05
11.4 ± 1.3[1]	82.5	2.68 ± 0.40	18.5 ± 0.8	0.75 ± 0.20	0.55 ± 0.05
9.59 ± 0.82	59.4 ± 1.8	3.59 ± 0.21	22.4 ± 1.5	1.65 ± 0.11	1.03 ± 0.09
10.8 ± 1.2[1]	146	3.10 ± 0.34	40.8 ± 2.2	1.17 ± 0.17	1.53 ± 0.06
10.9 ± 1.1[1]	172	3.11 ± 0.33	48.0 ± 2.6	1.35 ± 0.22	2.07 ± 0.08
11.7[2]	20.6	3.46 ± 0.13	6.10 ± 0.34	1.95[2]	0.34
13.0[2]	70.4	2.77 ± 0.11	15.1 ± 1.1	0.92 ± 0.01	0.34 ± 0.02
11.4 ± 1.1	46.7 ± 2.9	3.36 ± 0.23	13.7 ± 0.5	1.53 ± 0.21	0.62 ± 0.07
12.3[2]	117	3.04 ± 0.09	28.8 ± 0.8	1.00 ± 0.08	0.95 ± 0.05
[12.2]	[138]	3.09 ± 0.07	34.9 ± 0.5	[1.14]	[1.29]

[1] determined from only 6 plants.
[2] determined from only 3 plants.

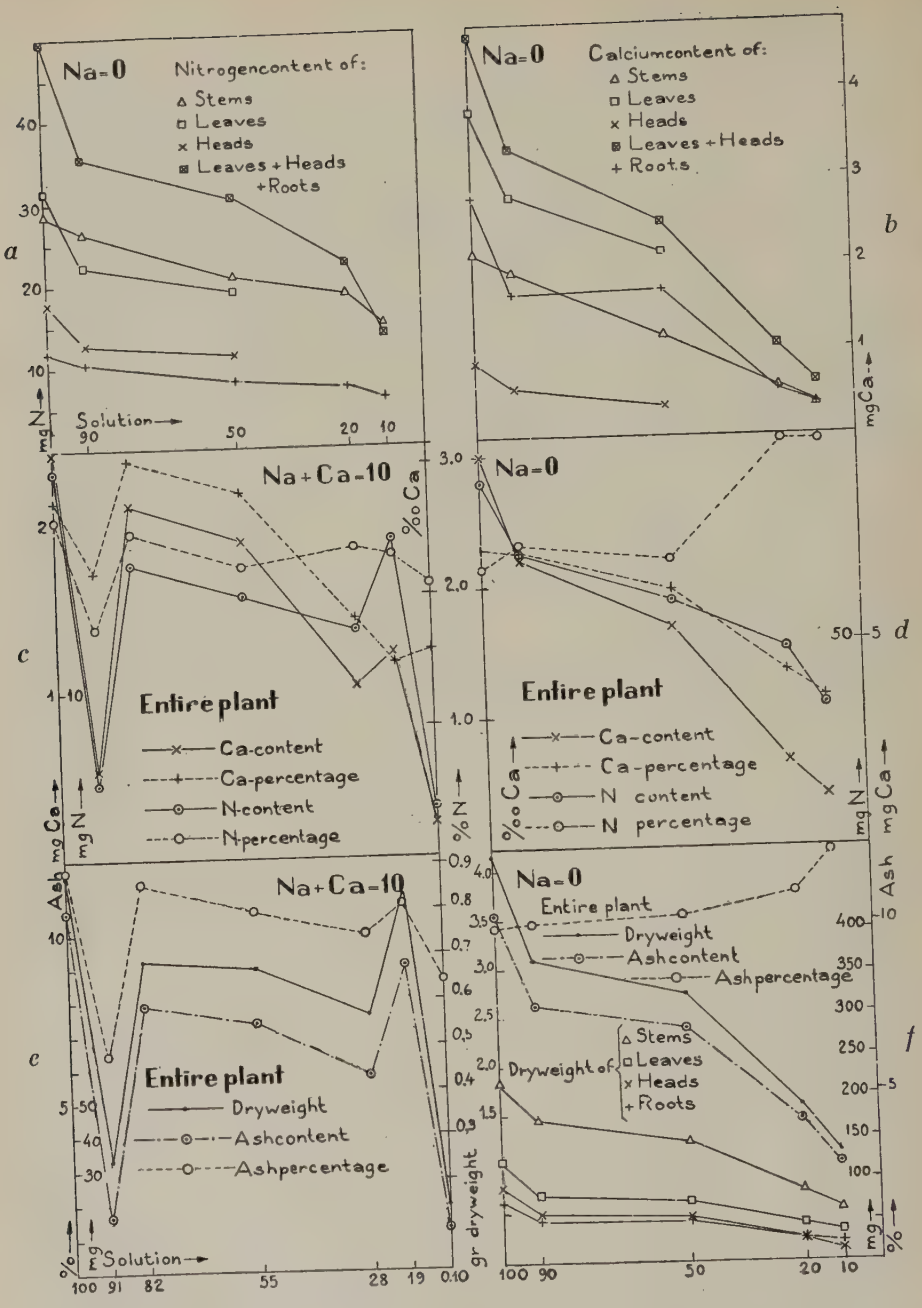

Fig. 2. Relation of growth and absorption to solutions. Experiments 1922—1923.

from 100 to 90 than from 90 to 50. The leave and head-curve is of the usual form with the exception of the aforesaid feature. The top and total curves also possess this feature, though in a lesser degree; for the remainder of the points it has the usual shape.

4. Absorption in Relation to Solutions.

The total calcium and nitrogen content curves may be considered as also expressing the absorption of the substances, since the seed content of the substances must be of a lower order of magnitude than the contents of the plant, which has been growing for two months.

Series without Sodium (1923). *Calcium Content Curves.* The calcium content curve for the stem is a straight line (fig. 2 *b*). The leave and head-curve shows a slight tendency to deviate from a straight line at point 90. The root-curve shows this tendency in a sharper degree. The top curve does not essentially deviate at point 90. The straight lines to which, with the above restriction, the calcium content curves of the totals, tops and stems tend, pass through, or nearly through, the point (0.0). This should also be the case when the curves of leaves, heads and roots are to be considered as a straight line. This points to a direct proportionality between calcium absorption and calcium concentration. In the dry weight curves no stress was laid upon the tendency of forming a straight line, as no relation to other investigations could be discovered.

Bondorff is of the opinion that a direct proportionality does exist between the absorption and amount present in the solution of a soluble substance. (Bondorff, 1924, p. 324, where a curve is evolved from experiments published by Pfeiffer, Simmermacher and Rippel, 1919, compare, however, Rippel, 1924, p. 308 and 1922, p 18.) Baule (1925) propounds the formula $\xi = \alpha(1-e^{-\gamma x})$, where ξ is the amount absorbed of the ion, x the amount present in the solution, and α and γ constants, with other values than those of the dry weight curves, which should follow a formula of the same form. Keeping in mind that these formulæ are only to be considered as approximative and not laying any stress at all on their theoretical foundation, as has been pointed out by

Rippel (1925, p. 8)[1] and in the paper by the author (1924), they are very useful for expressing the general features of the curves they are said to express.

Baule (l. c. p. 146) has calculated a curve according to his formula from values given by Pfeiffer and others (l. c.) on the absorption of phosphoric acid, which is not a soluble substance, and thus the truth of Bondorff's conclusion (see above) is not affected by this example. The curvature of this curve is, however, very vague. Practically the whole curve could be approximated with a straight line, at least in the interval in which the dry weight increases with the amount of the substance present in the solution, as Baule himself admits (p. 150). Now Baule has derived his mathematical consideration from the assumption that the formula $y = A(1-e^{-cx})$ — where y is the dry weight — generally expresses the production of dry matter. This is, however, only true for that part of the plane in which the dry weight increases essentially, as has been shown by Bondorff (l. c. p. 308, the temperature curve shows this nearly too well, but other examples with variations in the ion-concentrations show this also). This is related to the fact that the formula does not reckon with inhibitive processes of the substances. Baule, who claims to be very stringent in his deductions (l. c. the introduction and the end), has thus admitted an approximately direct proportionality in the only part of the plane, where the foundations of his deductions stand the test, and, nevertheless, he states: »Es würde daraus (from the opinion of Rippel) die Proportionalität von aufgenommener und dargebotener Nährstoffmenge folgen, die tatsächlich nicht besteht, vernünftigerweise nicht bestehen kann». — Cf. also the slight curvature of the nitrogen-curve for oats, given by Tornau and Meyer (1929, p. 91).

We do not know whether direct proportionality does exist, but the conclusion that the curves can be approximated with a straight line is not contradicted by the fact that certain formulæ are pliable enough to approximate the curves as well as, or better than, the straight line.

The tendency of the calcium content curves to follow a straight

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[1] The criticism of the author's discussion of 1924 propounded by Rippel (l. c. p. 80) must be due to a mistake, which will be seen from a comparison with Philipson, 1924 (p. 358).

line through zero in the first part of the x-axis, established only with certain restrictions, however, is thus not contradicted by the investigations quoted. Nevertheless, the curves do not supply any material for testing BAULE's or BONDORFF's opinion of the relation between amounts present and absorption.

Nitrogen Content Curves. The nitrogen content curves for roots and stems can be duly approximated with straight lines, which do not pass through zero, but in the curve of leaves and heads deviations from the straight line are suggested at points 90, 20 and 10 (fig. 2 *a*); these deviations are also found in the top curves; and in the total curves (fig. 2 *d*) the deviations are only slightly suggested. It is nevertheless possible that this linear relation is essential, as the nitrogen absorption in the concentration 0 cannot be zero. BONDORFF kindly told the author some years ago that in hitherto unpublished experiments he had arrived at a conception of such a linear dependance. As far as is known to the author, these experiments have not been published so far.

Ash Content Curves. The ash content curves generally follow the same course as the dry weight curves (fig. 2 *f*).

Series with Sodium (1922). *Calcium Content Curve.* The calcium content curve for the 1922 experiment (fig. 2 *c*) reaches a sharp minimum at point 91, and a maximum at 82, and then falls off with a slightly marked maximum of 19. The relation between the calcium content and dry weight, will be discussed farther along, but it may already now be stated that the curves of dry weight (fig. 2 *e*) and calcium content (fig. 2 *c*) agree in the left part of the xy-plane, and the marked maximum of 19 in the dry weight curve is equalled by a slightly marked one in the calcium content curve. The economy with the calcium absorbed must thus be better in the right part of the plane.

Nitrogen Content Curve. The maximum in 19 of the nitrogen content curve (fig. 2 *c*) is more marked than that of the calcium content curve. Generally this curve agrees with the dry weight curve (fig. 2 *e*); the relation will be dealt with more particularly below.

Ash Content Curve. The ash content curve agrees very well with the dry weight curve (fig. 2 *e*).

5. Relation of Dry Weight to Absorption.

Percentage Curves. *Series without Sodium.* The relation between dry weights and absorption could at first be studied with the aid of the percentage curves. The percentage curves of nitrogen of 1923 (fig. 2 *d*) show all a tendency to rise with the decrease of calcium concentration, or in other words the decrease in nitrogen content is not so relatively rapid as the decrease of dry weights with decreasing concentrations of calcium. The effect of calcium must thus affect the growth of the plant as a whole relatively more than it does in so far as nitrogen assimilation is concerned. This thesis will be used farther along. As was to be expected, the calcium percentage curves of the same experiment show a tendency to decrease with decreasing concentration, thus the effect of the variation of the amount of calcium present in the solution on the whole growth is not relatively as high as its effect upon calcium absorption. Cf. Tornau and Meyer, nitrogen percentage curve for oats (1929, p. 93).

Series with Sodium. The percentage of calcium from 1922 (fig. 2 *c*) has from 82 and onwards the same general tendency of falling off with decreasing calcium concentrations as was established in 1923 (fig. 2 *d*). To the left of 82 the curve has a sharp minimum in 91, and the value in 82 exceeds even that in 100. The nitrogen percentage curve of the same experiment (fig. 2 *c*) agrees with the calcium percentage curve to the left of 82, and falls also off to the right of 82, but by no means as rapidly as the calcium percentage curve. The presence of sodium has, however, depressed the nitrogen percentage curve which can be seen by comparison with the same curve in the series without sodium (fig. 2 *d*).

This may also be expressed in terms of the relation between dry weights and nitrogen contents. The maximum of the dry weight curve (fig. 2 *e*) is relatively higher than that of the nitrogen content curve (fig. 2 *c*) (and a fortiori than that of the calcium content curve). The antagonism which was proved to be the cause of the dry weight maximum at 19 in Philipson (1924), exercises the greatest influence upon the production of dry matter at 19; exercises a very slight influence upon the calcium absorp-

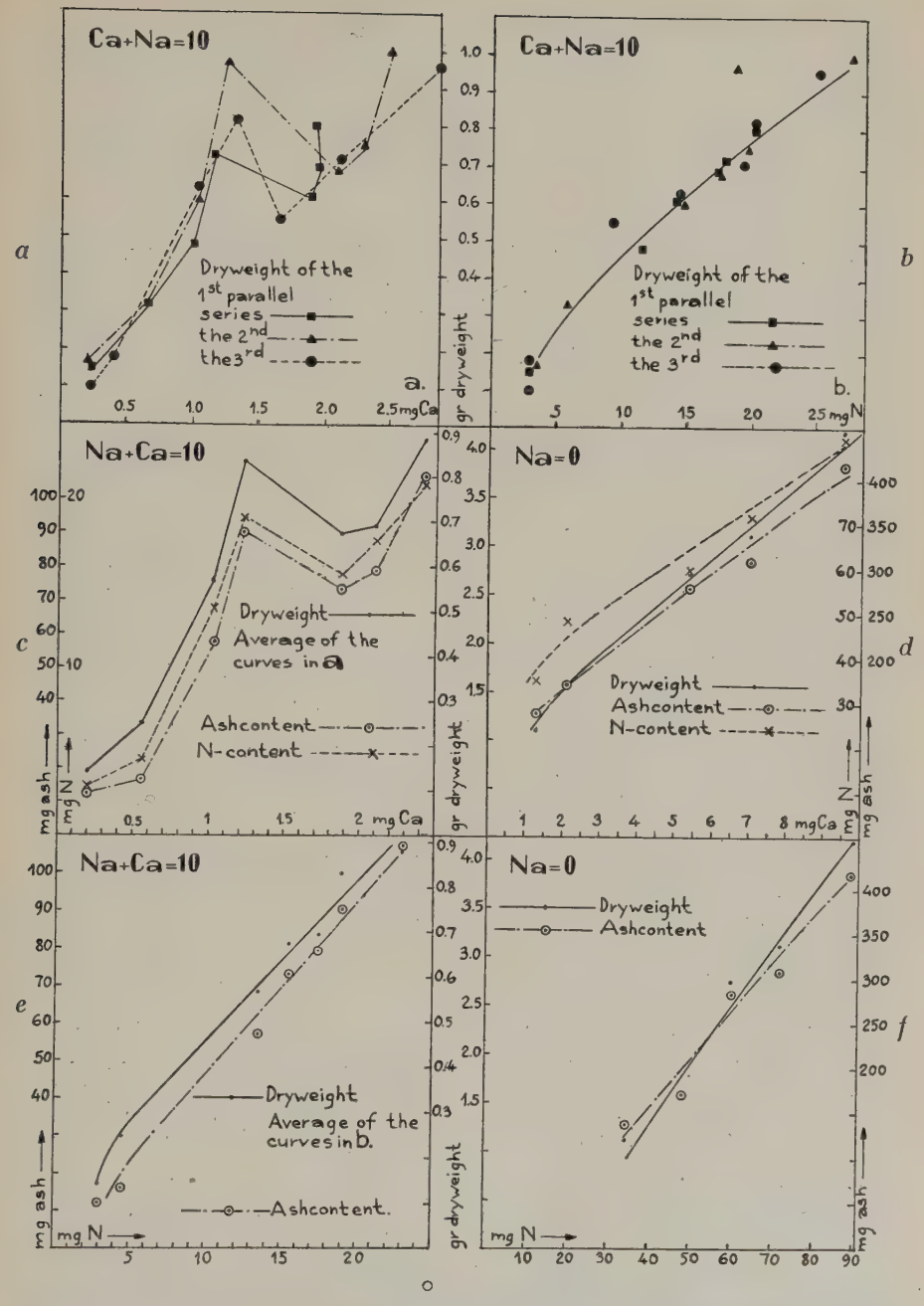

Fig 3. Relation of growth to absorption for entire plants. Experiment 1922—1923.

tion; and its influence on the nitrogen assimilation is intermediate between the other influences, as far as absolute amounts are concerned. As will be stated farther on, this is not the case if the relative utilization of the amount of calcium present in the solution is concerned (p. 187—189).

Dry Weight as a Function of Absorption. *Nitrogen.* In the second instance the relation between dry weights and absorption may be expressed by plotting the dry weights against the amounts absorbed. This is done in respect of nitrogen in figures 3 *e—f* and 4 *f*. In the 1923 series (*f*) all the curves are of a very simple shape within the limits of the mean error. All the dry weights increase regularly with an increasing amount of nitrogen. It is rather surprising that the corresponding curve of the series with sodium (*e*) is very simple. This curve represents in fact one of the two simple relations which could be stated between any values of the 1922 experiment. — Fig. 3 *b* shows the values of the three parallel series from which the average curve has been derived. The coincidence is fairly good. — The arrangement of the values in this curve means a change in the sequence of crops used at plotting the other curves. In this curve the crops are arranged according to the nitrogen absorption which has taken place; in the previous curves the harvests were classified according to the ratio of the calcium and sodium content in one litre of the solution. As this arrangement results in the same simple relation that exists in the series without sodium, it must be concluded that the presence of the sodium does not affect this relation of the nitrogen assimilation to the total production of dry matter. Thus, the influence of sodium on the internal processes which correlate the amount of nitrogen absorbed and the production of dry matter, is of no importance, whereas the influence on the absorption of nitrogen, however, which is essentially related to actions upon the root membranes, is very pronounced.

Hansteen [Cranner] (1910, p. 367—369), Mevius (1927) and Osterhout (1922) have all proved essential relations between actions upon the root membranes and antagonism, as has been pointed out above (p. 156). Reed (1918, cf. Reed and Haas, 1923), however, has suggested a relation between antagonism and internal

processes; reference to his results shall not be made without referring to Mevius' well-founded criticism of them (1925, compare also Philipson, 1924, p. 359 and Arrhenius, 1926, p. 76). Internal actions related to antagonism are assumed by Le Clerc and Breazeale (1920) found by Hansteen Cranner (1914) and Iljin (1923, 1924 *a*, cf. Giessler, 1928) as will be discussed below.

The ash content has also been plotted against the nitrogen absorption in the same figures, and the same relation as stated for the dry weights to nitrogen absorption does exist also in so far as the ash content is concerned. This points to a simple relation of dry matter production to ash content for both series, and consequently this relation is also essentially independent of the presence of sodium.

Calcium. The relation of dry matter production, nitrogen absorption, and ash content to the absorption of calcium can be seen in the figure 3 *c*—*d* and figure 4 *e*, where the latter values have been plotted on the x-axis. For the roots from 1923 the curve for dry weights has a very regular and simple form; the curve for the nitrogen content is more irregular, which may be due to occasional errors (fig. 4 *e*). The top curves have all essentially a simple form, the curves of stems, leaves and heads all tending to inflect more or less. In the resultant total curves of 1923 (fig. 3 *d*) the discrepancies have been more or less smoothed out, so that regular curves of a simple form for dry weight and ash content have been obtained. Rippel (1922, p. 20—21 and 1924, p. 72) claims for this curve the formula $y = A(1-e^{-cx})$, where y is the dry weight obtained, A is an extrapolated value of dry weight, c is a constant, and x the amount of the ion absorbed. Baule (l. c.) claims the formula $y = A\left[1-\left(1-\frac{\xi}{\alpha}\right)^{c/\gamma}\right]$, where the constants A, c and α, γ are calculated from the dry weight curve and the absorption curve respectively. Bondorff (1924) has generalized the foundations of the formula, for the purpose of describing also greater absorption values than in the curves of this paper. Thus, his formula, though giving a more adequate idea of the processes involved, need not be considered here, as it can be approximated with both Baule's and Rippel's formula, for the absorption values here concerned. But on account of the pliability of all these functions it will suffice to consider only one of them for comparison with the curve. For both

formulæ result in a curve essentially similar to that plotted in fig. 3 *d*, as will be seen from the figure on p. 149 of Baule's paper (1925) and tab. 32, p. 72 in Rippel's paper (1924). An establishment of the fact as to whether one or the other formula better fits the results, is of no use, as will be seen from the discussion here before. The fact to be emphasized is that the curve of figure 3 *d* essentially agrees with all experiments, which have been used to test the formulæ laid down by Baule and Rippel. Here mention may also be made of the relation of the dry matter production and the ash content to the nitrogen absorption for both experiments, which are demonstrated above by the curves of figure 3 *e* and *f*, of the same shape as the curve concerning the calcium absorption of the 1923 experiment.

The relation between the dry matter production, ash content and nitrogen assimilation to calcium absorption of 1922, expressed by the curves of fig. 3 *c* is, however, of a distinctly different type. — Fig. 3 *a* shows the values of the three parallel series from which the curve of dry weight has been derived. All the curves show the same course as this. — This relation, compared with that of the series without sodium, points to an effect exercised by the presence of sodium, which involves internal actions. Hints of such internal actions have been thrown out by Reed (1918) and Le Clerc and Breazeale (1920). As far back as 1909 Hansteen [Cranner] found that pure calcium solutions affect the water balance of different cereals in different ways; the absorption of water related to the dry weights of the roots was decreased and the transpiration related to the dry weights of the tops was increased, pure potassium and sodium solutions exercised an inverse effect on both processes, potassium, however, exercising a greater influence on the absorption, and a minor influence on the transpiration than sodium. Mixtures of calcium and potassium resulted in transpiration and absorption essentially higher than these values for pure potassium. The only experiment which gave comparable results of sodium and calcium is recorded in table 2, p. 541 of Hansteen Cranner (1914). (The whole quotation is taken from this paper.) It shows a great difference between the two ions as far as their actions upon transpiration is concerned. (Compare also Boswell, 1923, and Huber, 1925, p. 27—29.) Reed (1910) came to similar conclusions in an investigation into soil and solution cultures. The decrease in transpiration

was correlated with better economy with the amount of water required per unit of growth measured by green-weight. The economizing action of $NaNO_3$ was greater where the greatest acceleration of growth was produced.[1] All this points to internal actions, which may be involved in the causes of the relation between the calcium absorbed and the production of dry matter.

6. Relation of Dry Weights and Absorption for Corresponding Points of each Series and Calcium Utilization.

Finally, the curve of the antagonistic effect derived on three assumptions, between broad limits arbitrarily chosen (Philipson, 1924) is, calculated on the first assumption of the combination of the two effects according to the multiplication formula, rendered in figure 4 *c* together with the antagonism curve of the calcium contents, nitrogen contents and ash, calculated in the same way. The calcium utilization of 1922, i. e. the proportion between calcium absorption and the amounts of calcium present in 100 cc. of the solution, has been plotted in the same figure. The utilization curve for 1923 is plotted in fig. 4 *d*, on a scale whose ratio to the scale of the other curve represents the amount of solution at the disposal of each plant in the two cases.

The last-mentioned utilization curve shows a slight tendency to rise with the decrease in calcium concentration; the curve should thus tend to the same form as Baule, 1925, has plotted in his figure 2 (p. 148) and Tornau and Meyer, 1929 (p. 94, cf. also Niklewski and collaborators 1928, p. 106). The course of the curve of the series without sodium can within the limits of the mean errors be approximated with a straight line parallel to the x-axis. The utilization curve for the series with sodium (*c*) shows, however, a comparatively very high increase in this part. The differences between the utilization curves are thus expressed by the latter. Or, in other words, the influence of sodium is expressed in all its essential features by the utilization curve of the experiment with sodium, and that is true without the setting up of any hypothesis. A glance at fig. 4 *c* shows the essential and close agreement

[1] Iljin has concluded from experiments with leaves immersed in different salt solutions, that the ions calcium and sodium affect differently the dissimilation of starch (table 7, p. 107, 1923, cf. also 1922 and 1924 *b* and Giessler, 1928) in a certain correlation to plasmolysis.

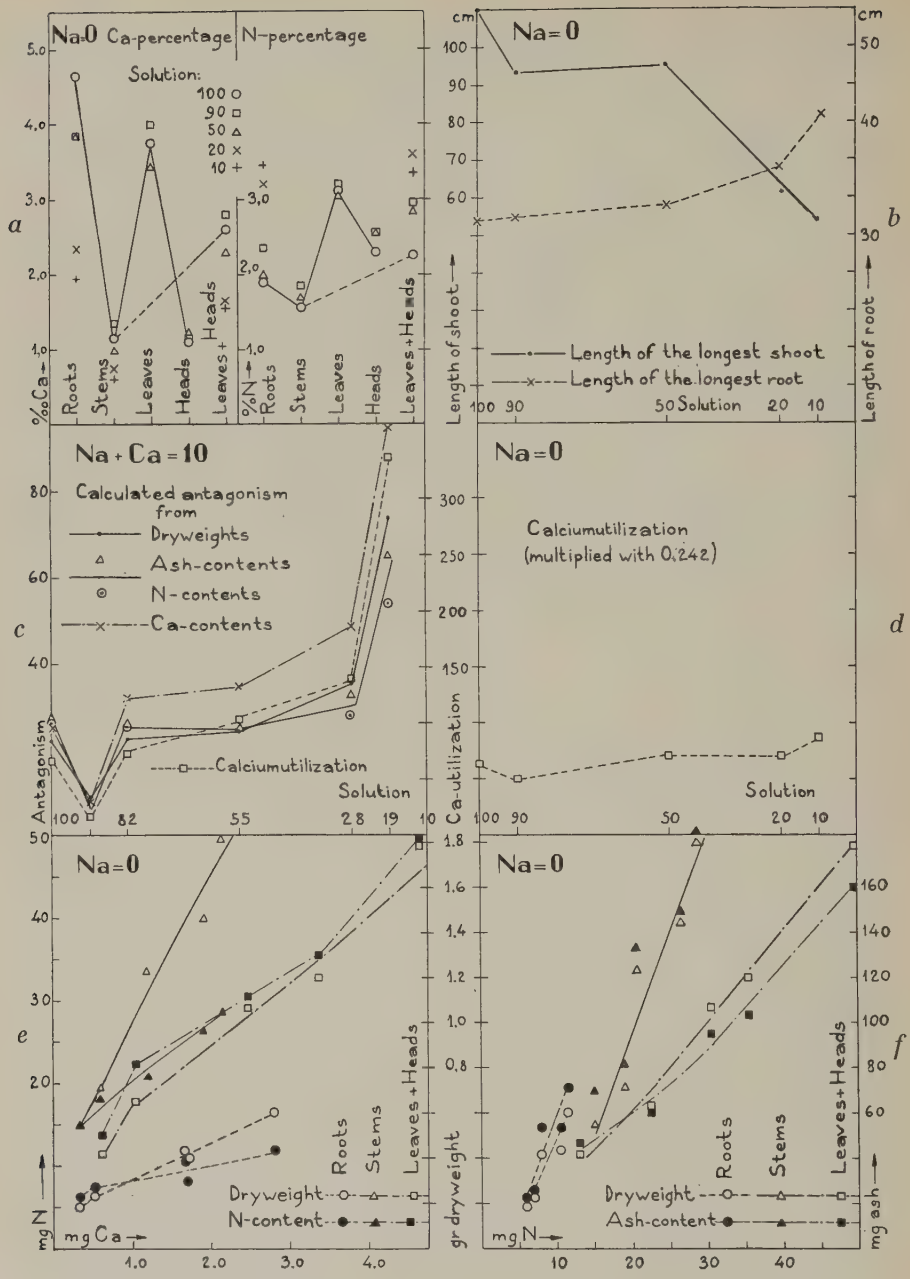

Fig. 4. Relation of the growth of different parts of the plant to absorption and height, root length, antagonism and utilization to solutions. Experiment 1922—1923.

between the utilization curve and the antagonism curves, which are all constructed with the aid of a hypothesis. The discussion on pages 362—365 in PHILIPSON, 1924, which leads to the construction of the antagonism curve as a manifestation of the effect, which, combined with the nutritive effect of calcium, is involved in the causality of the dry weight production of the 1922 experiment, is fully confirmed.

Thus, the utilization of the amount of calcium at the disposal of the plant expresses the causality of the phenomenon under consideration previously defined as antagonism (PHILIPSON, l. c.). The utilization must depend on the permeability, in the chemical sense of the word, of the root membranes. This antagonism, closely related to permeability, seems to be the most prominent member of the causal relations. The nitrogen absorption is also influenced by a process of the same nature, as was suggested above. But then it has been previously stated that an antagonistic action must also take place within the plant (p. 186). This action is implied in the antagonism curve, and we may therefore also assume its implication in the calcium utilization curve, which shows a close agreement with the first-mentioned curve. Nor must the calcium utilization depend only on the permeability of the root membranes. This may be explained by the aid of a simple physical-chemical model. Suppose that two vessels, communicating with each other by a membrane, contain the same substance in different concentrations, the one being kept constant through the successive addition of fresh solution. In the other vessel chemical reactions are supposed to occur, which decrease the dissolved amount of the substance in question at a certain rate; it is clear that the amount of the substance that will pass the membrane, must vary with alterations in this rate. A similar discussion is given by OSTERHOUT (1917 *b*, p. 318). — The calcium utilization is certainly not independent on internal processes. The curve of calcium utilization thus probably represents at least two processes, which together are involved in the causality of the dry matter production (cf. also p. 216).

The antagonism curve of nitrogen absorption displays the same features as the other antagonism curves (fig. 2 *c*).

7. Comparison between the Different Parts of the Plant as to the Distribution between them of Nitrogen and Calcium.

Finally, without the scheme of the discussion given above the 1923 results may be compared on another basis as to the relation of the different parts of the plant in each solution. This comparison is made in figure 4 *a*. The relation of the calcium percentage is essentially the same in all solutions, being higher in the leaves than in the heads, while the roots contain a higher percentage than the stems. This indicates that during the ripening process a very rapid flow of calcium must occur from the leaves to the heads, as is also to be expected. The curves for the nitrogen percentage in figure 4 *a* show the tendency to form a maximum in the leaves.

The comparison of the calcium percentages of roots and tops shows good agreement with HOAGLAND's (1919, p. 83 and 86) statement of the accumulation of calcium i the roots. The percentages of nitrogen in roots and tops respectively vary from case to case, though HOAGLAND was able to demonstrate the accumulation in tops. But he varied the concentrations of all salts at the same mutual ratio, and his results are therefore not comparable with those of the present experiment, where only the calcium concentration was varied.

V. EXPERIMENT 1923 B.

In order to investigate the influence of the variation of the sodium concentration between wider limits than those given in figure 1, the following experiment was carried out. Six different solutions were used, five having a calcium concentration of 10, one one of 5. The sodium concentrations were 1.1, 2.5, 10, 40, 90 and 45 respectively. The proportions in these solutions between sodium and calcium concentrations were thus equal to the same proportions in the solutions 91, 82, 55, 28, 19 and 19 respectively. The arrangement of the cultures was the same as in the chief experiment of 1923, previously described, with the difference only that the number of plants in each point was limited to five, the period of growth being only 41 days. The height of the plants was measured once during growth — 26 days after planting — and on being

Table VI. **Experiment of 1923 B. Averaged values.**

Dry weight etc. on harvesting.

Solution		Number of plants	Number of tillers	Root length cm.	Dry weight pr plant mg.				Total
Ca	Na				Roots	Stems	Leaves	Top	
10	1.1	4	3.5±0.3	28.7±0.9	420±43	852± 83	968± 44	1820± 92	2241±105
10	2.5	4	2.8±0.3	23.2±0.8	498±65	909±132	820±101	1729±151	2227±181
10	10	5	3.0±0.3	24.8±1.0	404±32	728± 33	733± 45	1461± 72	1865± 75
10	40	5	3.2±0.4	21.8±2.8	328±68	687±104	616±138	1302±240	1630±305
10	90	4	2.0±0.0	24.8±0.9	199±60	826± 55	492± 59	1318± 82	1517±136
5	45	4	2.8±0.5	25.5±5.0	256±49	837±103	569± 52	1406±136	1662±145

Length of the longest shoot.

Solution		Time from plantation	
Ca	Na	26 days	41 days (harvest)
10	1.1	48.7 ± 2.5	70.5 ± 6.3
10	2.5	43.8 ± 0.6	66.5 ± 2.7
10	10	48.3 ± 1.7	76.0 ± 5.0
10	40	45.2 ± 1.7	74.0 ± 5.1
10	90	47.4 ± 1.9	75.5 ± 4.7
5	45	52.7 ± 2.5	79.8 ± 4.7

harvested. The dry weight of roots, leaves and stems was estimated, and the length of the longest root and the number of tillers was also recorded. The results are rendered in table VI and in the graphs figure 5.

The differences in the curves are all very slight and only certain general tendencies of the curves could be traced. In all cases the enveloped signs of each curve, representing the growth in solution (5, 45), is to find above the sign representing growth in solution (10, 90). These two solutions, with the same proportion between their calcium and sodium concentrations as solution 19 of figure 1, differ only in so far as the concentrations are doubled in the latter. The height curves for Ca = 10 (fig. 5 *b*) show both a minimum in

(10, 2.5) and a slight maximum in (10, 10), and, finally, a tendency to form a minimum in (10, 40) and a maximum in (10, 90), these curves thus showing a certain similarity to the curve of dry weights in 1922, fig. 2 *e*, although with much less marked differences. If the height of the plants could be considered as a correct measure of growth, which is not true, as will be pointed out below — this should point to the conclusion that similar effects of the proportions of the concentration to those found to exist in the solutions of 1922, should also exist in the series of solutions with Ca = 10 and widely varying sodium concentration.

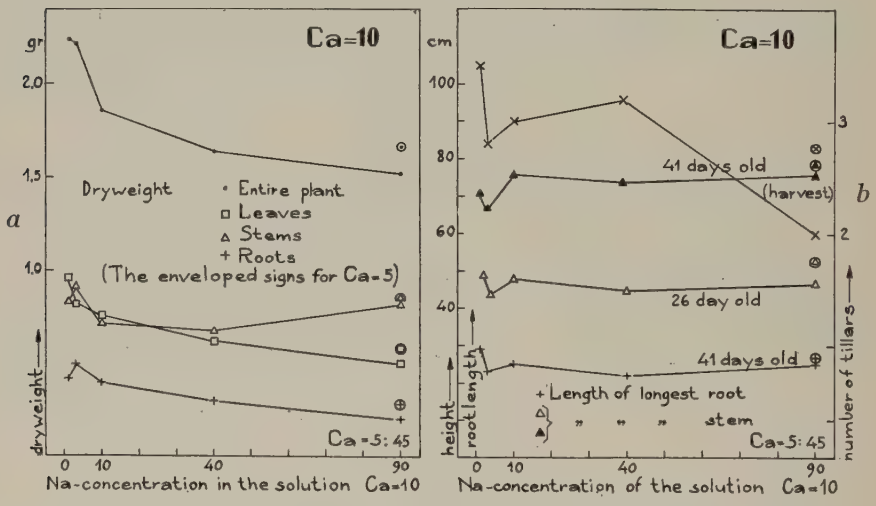

Fig. 5. Relation of dry weight, height, root length and tillering to solutions. Experiment 1923 B.

The height of the plants does not, however, represent the growth, as will be seen from the curve of the total dry weights (fig. 5 *a*). This curve decreases monotonously with increasing sodium concentrations; the leaf curve has the same tendency. The curves of roots and stems have both a slight maximum at point (10, 2.5), which may be a faint indication in this early period of growth to the same maximum which was found in the curve Ca = 10 for solution 102 of experiment 1924 (see fig. 10 *c*). The rise in the height curves from (10, 40) to (10, 90) is only equalled by the rise in the dry weight curve of the stems. In the weight of the tops of (10, 90) this maximum is nearly equalized by the decrease

in the weight of the leaves. Thus the dry weight curves do not support the course of the height curve from (10, 2.5) to (10, 40), the maximum in (10, 90), being only supported by the stem curve (compare also the height curves of 1924, compared with the dry weight curves of tops fig. 10 *c*). The number of tillers is, however, diminished in the last mentioned point (fig. 5 *b*).

Finally, the length curve of the longest root has the same course as the height curve. If we compare this with the root-length curve in the chief experiment of 1923 (fig. 4 *b*), we shall come to the conclusion that the length of the longest root is antibatic with the dry weight of roots (compare this conclusion with those of Eisenmenger, 1928, p. 299 and 300, 1 and 4 respectively). As to whether the latter value is to be considered as the correct measure for root-growth or the aggregate length of roots as defined by Osterhout (1907), must be regarded as a matter of convenience, until some facts in favour of one or other have been found, when the variation in root-thickness will have to be taken into consideration. Osterhout's table VII (l. c.) must have given him a great deal of work. Finally, he does not describe how the measurements on the whole were made possible without any alterations in the root lengths, during the long time this work must have been going on. No discussion of the method in question is found in his monograph (1922) on the subject, though similar experiments are recorded there (p. 127). Thus, this method of measuring root-growth, as it may be gathered from the papers quoted, is in need of discussion both as to its advantages from a standpoint of principle to the simple dry weight estimation, and of the possibility of avoiding experimental errors implied.

No more definite conclusion of the curves of figure 5 than this analysis, will be given, as the number of plants is too small in each point to permit of more than tracing the general tendency of the results.

VI. EXPERIMENTS OF 1929.

1. **Conditions of the Experiment.**

In order to get an idea of the growth during the earlier part of the vegetation period, the plants of these experiments were harvested one to three weeks after planting. The constant

drip was secured by the following arrangement. Each culture solution was kept in a 10-litres flask with a rubber stopper with two holes. In one of these holes was inserted a branching siphon with six outlets, each of which was at the same height above the table. Each branch of the siphon reached to the bottom of a $^2/_3$-litre jar of well-glazed porcelain. These six jars were placed in an iron casing with an outlet at the lower edge. The iron casing had a cardboard lid, prepared with paraffin, just above the upper edge of the jars. In the lid there were six holes just above the porcelain jars and with diametres a trifle shorter than those of the jars. Over each of these holes there were placed perforated tablets of the same prepared cardboard holding sixteen plants, fastened with cotton-wool.

Through the other hole in the rubber-stopper of the 10-litres flask was run a tube, one end of which passed just above the end of the siphon into the flask. The other ends of these tubes from all 10-litres flasks were connected with branching tubes with one 60-litres carboy, the distance along the connecting tubes from each 10-litres flask to the carboy was equal throughout the system. Each of the 10-litres flasks was thus as long as the air pressure was maintained in the carboy a constant pressure flask which secured a constant level of the free solution surface in the porcelain jars just beneath the upper edge of the jars. A higher pressure was then attained in the carboy through siphoning a constant flow of tap-water through a capillary siphon leading from a constant pressure flask, through a rubber-stopper into the carboy. This excess of pressure was adjusted to such a degree as to give an appropriate flow of the culture solutions from the 10-litres flask through the siphons to the porcelain jars; the free surface of the solution in the jars was thus raised to the edge of the jars, where it was kept constant through overflow. The overflow passed off into the iron casing, and was conducted away through its outlets. The possible variation in the rate of the solution-current, through differences in temperature etc., was through this arrangement nearly the same in all solutions.

Three of the jars of each set were planted with one set of plants; and six days later, the rest with another. The plants were germinated on filter paper. The temperature during germination and up to the end of the experiment varied in the greenhouse

within wide limits; it was on the whole fairly high and tended to increase during the experiment. One day after planting some of the plants in each jar were dead; these were discarded and the gaps were filled with new plants. The weighed averages of the time from the plantation to the harvest of each jar was considered as the growth time for the jar, the faults committed by this method are negligible in comparison with the biological variation of material.

All the plants from one jar were dealt with together, separated into tops and roots, dried at 104° after preliminary dessicating at 60°, and weighed with an accuracy of 5 cgrs. The total calcium content of tops and roots was determined after the method described above; the grinding and mixing of the material were thus rendered unnecessary, i. e. one of the most prominent faults of the analysis was avoided. Taking this into consideration it seemed irrelevant to make parallel analyses, as the faults introduced through this must be very small compared with those due to the biological variation of material. This variation was determined by weighing and analysing ten samples of each ten seeds and two samples of plants at the time of planting, each containing ten plants. All results were calculated per plant, and may be formulated for each solution as the following relations: total dry matter to time; total dry matter to calcium content; and calcium content to time and corresponding relations for the roots and tops respectively. In comparing the solutions we obtain six relations of dry matter production, six of Ca-contents to the concentration in the solution for each total, top and root.

The dry weight and calcium content of one seed, averaged of ten samples of each ten seeds, was 28.5 ± 0.6 mg. and 0.022 ± 0.001 mg. For one plant at planting (averaged of 2×10 plants) the corresponding figures were 22.3 ± 0.5 mg. and 0.021 ± 0.006 mg. The corresponding figures for the harvests are given in the tables VII—XII.

2. Growth and Absorption in Relation to Time.

The growth in relation to time is demonstrated with average curves in fig. 6 *b* and *e*, the averages for all solutions of each harvest being plotted against time, the values for the plantation against time equal to 0.

Table VII. **Experiment of 1929. The first harvest.**

Solution	Growth time days	Number of plants	Dry weight pr plant mg.			Calcium content pr plant mg.		
			tops	roots	total	tops	roots	total
100	7.8	16	11.4	14.9	26.3	0.047	0.094	0.141
91	7.9	14	7.5	17.7	25.2	0.027	0.077	0.104
90	7.9	12	9.5	17.9	27.4	—	0.058	—
82	7.9	15	8.1	17.5	25.6	0.021	0.055	0.076
73	7.6	13	10.7	16.6	27.3	0.035	0.068	0.103
70	8.0	15	10.5	14.0	24.5	0.032	0.058	0.090
64	7.7	14	11.5	17.9	29.4	0.048	0.096	0.144
55	7.8	16	11.6	17.2	28.8	0.036	0.059	0.095
50	7.9	14	13.9	17.6	31.5	0.044	0.064	0.108
46	7.8	14	6.6	17.4	24.0	0.016	0.042	0.058
40	7.7	15	9.9	18.9	28.8	0.028	0.045	0.073
37	7.6	12	8.0	17.9	25.9	0.019	0.053	0.072
28	7.8	16	12.1	17.7	29.8	0.025	0.048	0.073
20	7.6	15	11.5	15.0	26.5	0.037	0.033	0.070
19	7.5	9	6.1	17.4	23.5	0.019	0.031	0.050
10	7.6	10	6.3	18.5	24.8	0.011	0.049	0.060

Table VIII. **Experiment of 1929. The second harvest.**

Solution	Growth time days	Number of plants	Dry weight pr plant mg.			Calcium content pr plant mg.		
			tops	roots	total	tops	roots	total
100	11.0	12	13.9	17.0	30.9	0.080	0.194	0.274
91	9.3	11	14.0	18.6	32.6	0.038	0.068	0.106
90	10.3	9	12.4	19.0	31.4	0.047	0.096	0.143
82	9.9	13	11.3	16.2	27.5	0.069	0.127	0.196
73	9.8	15	14.9	17.4	32.3	0.071	0.121	0.192
70	10.7	11	16.6	15.5	32.1	0.087	0.118	0.205
64	11.0	12	13.5	18.6	32.1	0.061	0.126	0.187
55	9.3	13	10.3	18.8	29.1	0.037	0.056	0.093
50	10.7	13	16.8	16.7	33.5	0.094	0.086	0.180
46	10.7	15	14.7	15.6	30.3	0.081	0.049	0.130
40	10.7	14	16.6	16.9	33.5	0.064	0.090	0.154
37	9.6	10	14.0	20.1	34.1	0.062	0.069	0.131
28	9.6	14	11.0	17.8	28.8	0.023	0.052	0.075
20	11.0	14	14.4	16.8	31.2	0.032	0.061	0.093
19	10.0	4	7.5	18.8	26.3	—	0.051	—
10	9.5	13	12.2	15.6	27.8	0.042	0.045	0.087

Table IX. **Experiment of 1929. The third harvest.**

Solution	Growth time days	Number of plants	Dry weight pr plant mg.			Calcium content pr plant mg.		
			tops	roots	total	tops	roots	total
100	15.0	10	30.9	22.4	53.3	0.149	0.135	0.284
91	15.0	15	28.2	24.9	53.1	0.134	0.141	0.275
90	15.0	16	46.9	23.1	70.0	0.225	0.120	0.345
82	14.8	12	21.3	21.3	42.6	0.101	0.072	0.173
73	15.0	12	22.7	26.4	49.1	0.152	0.084	0.236
70	15.0	12	31.3	24.4	55.7	0.131	0.135	0.266
64	15.0	10	31.4	25.6	57.0	0.155	0.184	0.339
55	14.5	11	31.7	24.7	56.4	0.132	0.084	0.216
50	14.8	12	24.1	24.6	48.7	0.095	0.074	0.169
46	14.6	7	23.1	23.3	46.4	0.070	0.128	0.198
40	15.0	15	43.2	28.5	71.7	0.166	0.164	0.330
37	14.4	15	17.5	14.8	32.3	0.047	0.041	0.088
28	14.9	5	14.0	20.2	34.2	0.030	0.089	0.119
20	14.5	14	23.9	23.9	47.8	0.068	0.038	0.106
19	14.6	9	29.2	25.0	54.2	0.120	0.032	0.152
10	14.6	15	40.0	21.5	61.5	0.120	0.066	0.186

Table X. **Experiment of 1929. The fourth harvest.**

Solution	Growth time days	Number of plants	Dry weight pr plant mg.			Calcium content pr plant mg.		
			tops	roots	total	tops	roots	total
100	16.8	7	49.4	35.3	84.7	0.264	0.285	0.549
91	16.0	4	50.3	35.3?	85.6	0.366	0.165	0.531
90	15.3	3	15.1	23.6	38.7	0.088	0.094	0.182
82	17.5	12	54.8	25.8	80.6	0.259	0.153	0.412
73	16.9	13	50.6	29.3	79.9	0.216	0.147	0.363
70	16.6	13	38.5	25.2	63.7	0.171	0.128	0.299
64	17.4	7	36.3	32.1	68.4	0.166	0.151	0.317
55	17.3	11	48.2	28.1	76.3	0.187	0.141	0.328
50	17.0	10	44.3	26.2	70.5	0.216	0.185	0.401
46	15.5	7	25.1	23.0	48.1	0.092	0.106	0.198
40	17.5	14	59.9	27.6	87.5	0.202	0.164	0.366
37	14.9	[2	27.5	21.5	49.0	0.085	0.076	0.161]
28	17.6	15	68.3	28.5	96.8	0.226	0.111	0.337
20	16.5	10	56.0	24.5	80.5	0.238	0.101	0.339
19	14.8	[1	16.0	13.0	29.0	0.055	0.064	0.119]
10	15.3	5	12.8	26.8	39.6	0.009	0.058	0.067

Table XI. **Experiment of 1929. The fifth harvest.**

Solution	Growth time days	Number of plants	Dry weight pr plant mg.			Calcium content pr plant mg.		
			tops	roots	total	tops	roots	total
100	22.0	15	87.3	31.9	119.2	0.278	0.250	0.528
91	22.0	13	118.3	42.2	160.5	0.357	0.252	0.609
90	21.9	14	115.6	35.4	151.0	0.346	0.174	0.520
82	22.0	14	90.3	32.8	123.1	0.286	0.221	0.507
73	22.0	14	109.8	39.6	149.4	0.350	0.260	0.610
70	21.4	13	89.5	32.1	121.6	0.292	0.152	0.444
64	22.0	15	87.8	48.9	136.7	0.256	0.304	0.560
55	22.0	10	100.1	45.0	145.1	0.344	0.236	0.580
50	21.4	5	110.6	42.8	153.4	0.413	0.194	0.607
46	22.0	14	82.4	34.6	117.0	0.239	0.137	0.376
40	22.0	16	109.4	45.6	155.0	0.301	0.222	0.523
37	21.4	13	90.0	43.4	133.4	0.243	0.161	0.404
28	22.0	[1	26.0	37.0	63.0	0.106	0.220	0.326]
20	21.7	12	66.3	28.3	94.6	0.146	0.083	0.229
19	22.0	12	130.2	37.6	167.8	0.205	0.108	0.313
10	21.5	14	106.5	50.9	157.4	0.187	0.084	0.271

Table XII. **Experiment of 1929. The sixth harvest.**

Solution	Growht time days	Number of plants	Dry weight pr plant mg.			Calcium content pr plant mg.		
			tops	roots	total	tops	roots	total
100	23.0	13	104.3	37.0	141.3	0.367	0.299	0.666
91	22.8	13	93.5	36.2	129.7	0.341	0.131	0.472
90	23.0	16	122.7	45.9	168.6	0.356	0.296	0.652
82	22.9	16	92.2	40.1	132.3	0.298	0.203	0.501
73	23.0	15	110.3	43.6	153.9	0.281	0.227	0.508
70	22.9	12	90.0	38.3	128.3	0.325	0.140	0.465
64	22.9	11	98.7	47.6	146.3	0.396	0.424	0.820
55	22.5	15	84.6	38.9	123.5	0.249	0.149	0.398
50	22.6	6	70.5	40.9	111.4	0.203	0.105	0.308
46	22.9	11	82.5	37.9	120.4	0.249	0.130	0.379
40	22.4	7	83.9	47.4	131.3	0.269	0.134	0.403
37	21.3	10	63.9	32.4	96.3	0.183	0.092	0.275
28	22.9	16	111.7	42.0	153.7	0.165	0.090	0.255
20	22.9	13	107.0	38.3	145.3	0.222	0.077	0.299
19	22.9	6	74.8	35.1	109.9	0.153	0.083	0.236
10	21.9	3	33.0	22.0	55.0	0.071	0.066	0.137

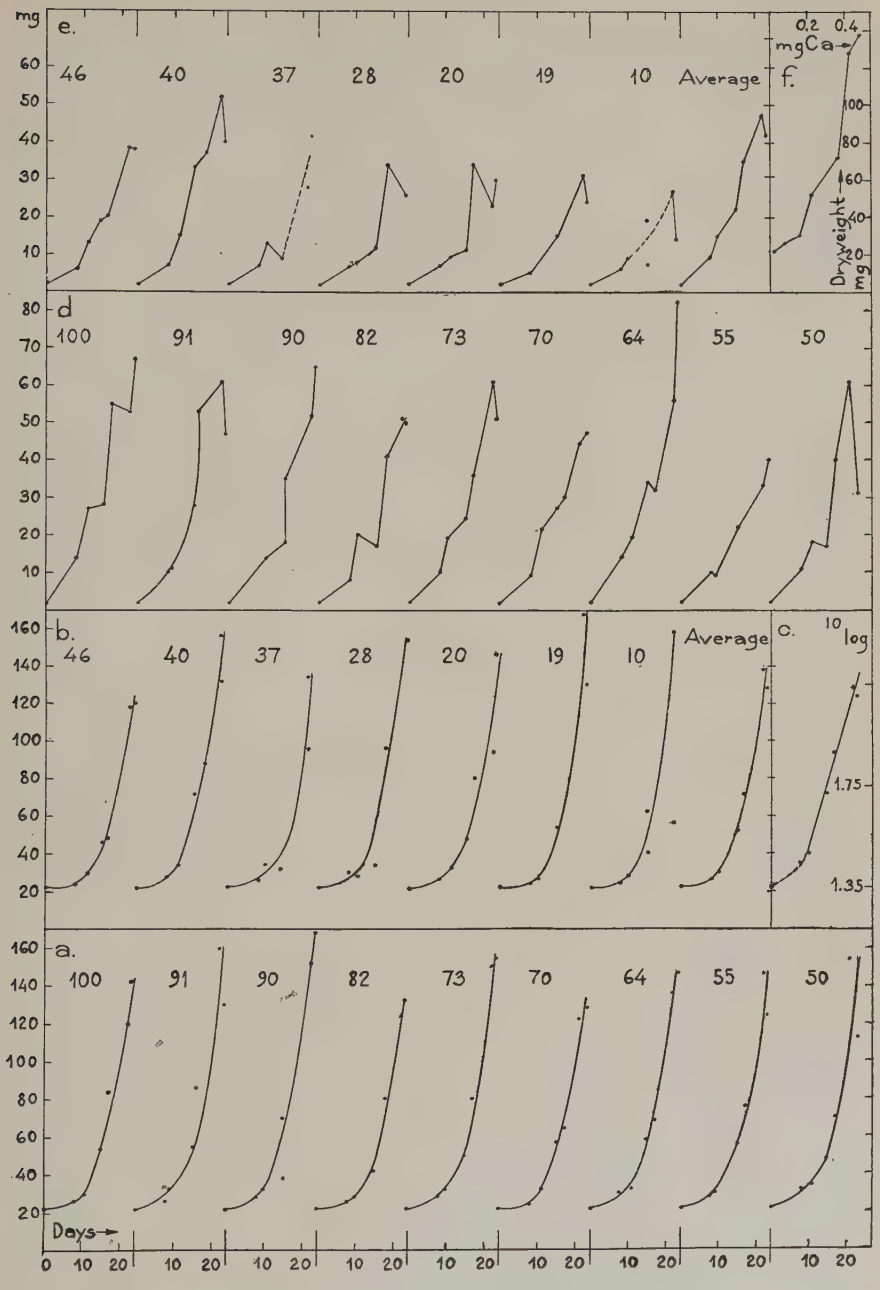

Fig. 6. *a—b* Dry weight. *c* Log average dry weight. *d—e* Calcium content, all related to time. *f* Average dry veight related to average calcium Content. Experiment 1929.

Dry Weight Curves. The relation of dry weight to time may be explained — as is seen by plotting the logarithms over time (fig. 6 *c*) — in the terms of Blackman's approximation formula (Blackman, 1919) if the discussion by Gregory (1921, p. 113 and 1926, p. 21) is taken into consideration. The curves for total dry weight over time for each solution tend all to the same form (fig. 6 *a* and *b*), even those for tops and roots. Deviations from this form are only found in the curves in the case of a few live plants in the deviating points, which shows that another factor has been of influence in the point of question.

Calcium Content Curves. The average curve (fig. 6 *e*) for Ca-content over time tends to a straight line from the first harvest to the end of the experiment. From plantation to the first harvest the increase in the calcium content is much more rapid than the increase in dry weight, and later on the increase in calcium content is less rapid than the production of dry matter. This was also said to occur, though in a slight degree, in the investigations by Pfeiffer, Rippel and Pfotenhauer (1921, p. 146—150). Thus the percentage of calcium rises rapidly during the first part of the season, and then drops during the later stages. The separate curves for each solution, Ca-content over time does not always show the same aspect as the average curve (fig. 6 *d*—*e*). E. g. in solution 64 the curve increases rapidly in the last part of the time under consideration. Thence the first maximum of calcium percentage that is always found more or less pronounced, was followed by a second one in this solution. Calcium content curves of other forms too can be seen in figure 6 *d*—*e*, and this will be dealt with farther on.

Burd (1919) has investigated the growth and absorption of ions as a function of time for a period of 18 weeks in soil cultures. In his two experiments the relation of growth to time may be expressed in the terms of an S-curve with the point of inflexion at 8 and 11 weeks respectively (this form is in accordance with the curves by Gregory, 1926, and Pfeiffer, Rippel and Pfotenhauer, l. c. p. 151). Thus the curves during the first eight weeks should all be of the normal logarithmic type, which was also found in the present paper for the period of the first three weeks. Burd's curves for the amount of ions absorbed show a marked loss of nitrogen and potassium, and in one experiment a slight loss of calcium in the middle of the growth season. He states that

this decrease in the Ca-curve may be due to experimental errors, but if this is not true, it may be due to the same cause that affected the N- and K-curves (p. 62). Such a decrease has also been found by HOAGLAND (1919, p. 100, 95 and 99. Cf., however, PFEIFFER, RIPPEL and PFOTENHAUER, p. 147). In the latest period of growth, however, both experiments showed a marked decrease in the calcium curves. BURD's first harvest was made three weeks after planting; thus his curves did not show the variation in calcium absorption for the first part of the season. It seems, however, that the absorption curves are more complicated functions of time than the dry weight curves. (Cf. BREAZEALE, 1923, p. 43—44 and TRÖNDLE, 1918). From figure 6 *d*—*e* it can be concluded that the different solutions have different forms of absorption curves over time, in so far as the first three weeks are concerned. The curves for solutions 100, 90, 70, 64, 55, 46, 37 tend to a curve of the same general aspect as that of the dry weight curves, while the total curves of 91, 82, 73, 50 and 40 show a more or less marked tendency to inflect in the latter part of the period in question. The curves for the solutions 28, 20, 19, 10 have a still more irregular shape.

It is possible that this irregularity is due to experimental errors, and thus irrelevant. On the other hand, a certain regularity in the distribution of the forms over the concentrations studied may point to an essential correlation between the form of the absorption curve over time and the concentration of the solution. On the other hand, it is possible that the curve in all cases is essentially the same, but of such a complicated form, that the number of points is far too low to give an idea of the aspect of the curve. [Such a form might be a series of S-shaped curves as found by PRIESTLEY (1922 *a* and *b*) for root growth and BREAZEALE (l. c.) for K-absorption during the first three weeks]. It is nevertheless true — in spite of all restrictions — that the absorption of calcium during the first three weeks appears to vary in relation to time much more irregularly than the production of dry weight. Whether this may be explained as due to a greater variation in material in respect to its absorption power as compared with that of its production of dry matter, cannot be stated on the basis of the experiments here referred to. It is, however, probable that the pure line, in a practical sense of the word, is more uniform in the production of dry weight than in the absorption power towards mineral salts.

Correlation between Dry Weight and Calcium Content of Different Harvests. As the production of dry weight has such a simple relation to time, and the calcium content has a more or less complicated relation, at least in certain solutions, no simple function can be expected to represent the relation of dry weight to calcium content, at least as far as these solutions are concerned. In fact, the curves which demonstrated this relation oscillated more than might have been expected from the biological variation for the solutions concerned. As the material cannot be considered large enough to prove such an oscillating tendency, the curves in question have not been plotted here. As, however, this oscillation was suggested only by certain curves, the average curve plotted in figure 6 *f* must supply a further less pronounced suggestion of this oscillating tendency. If BURD's values (l. c.) were plotted according to the same method, i. e. the dry weights over the calcium contents, a curve would be obtained, which shows this oscillating well pronounced, for the period of growth considered in his paper or the latter part of the season. Finally, the complicated absorption curves for all electrolytes present in the solution, as has been determined by HOAGLAND (1919), point to a similar oscillating relation between dry weight and electrolytes absorbed.

The author maintains that such a treatment as has been suggested here of the crops at different stages of growth might perhaps elucidate fundamental causalities in plant nutrition if applied to a greater amount of material. Nevertheless, the problems which come within the scope of this paper are probably more specifically involved in these general causalities, and therefore the author refrains from giving more than these suggestions.

3. **Growth and Absorption in Relation to Solutions.**

The comparison between the effects of the different solutions upon the growth has been made by plotting the actual values for each harvest in two systems of curves, one for the solutions which do not contain sodium, with calcium as the only varied ion, and the other for the solutions containing sodium and calcium in varying concentrations, the sum of them being kept constant. The curves are given in figures 7 and 8, where a comparison between corresponding curves for the different harvests is given in

each graph. As it will be difficult to see what features may be common to these curves, without averaging them and comparing each of them with the average, an average has been calculated for the entire plants. There is, however, no reason for one method of averaging or another. If it were possible to find a mathematical transformation for which the curves of absorption and dry matter production over time should give a linear dependance, the average of thus transformed values would give the most correct average of the curves in each case. Such a transformation, however, is of no importance, because of the great variation in material. Without laying any great stress on the correctness of the averaging method selected, the simple arithmetical mean has been calculated (table XIII) and plotted in fig. 9 *c* and *d*. In some of the curves, however, the smoothness of the curve thus averaged is fairly good (see for example the calcium absorption of the total plant for the series with sodium fig. 9 *c*).

Table XIII. **Experiment of 1929. Averaged values.**

Solution	Dry weight pr plant mg.	Ca content pr plant mg.
100	76.0 ± 3.0 (4.5 [1])	0.407 ± 0.026 (0.028 [1])
91	81.1 ± 2.3	0.350 ± 0.028
90	81.2 ± 14.0	0.369 ± 0.056
82	72.0 ± 2.3	0.311 ± 0.022
73	82.0 ± 1.5	0.336 ± 0.012
70	71.0 ± 5.5	0.295 ± 0.014
64	78.3 ± 3.0	0.395 ± 0.044
55	76.5 ± 2.2	0.285 ± 0.025
50	74.8 ± 3.8	0.295 ± 0.030
46	64.4 ± 4.4	0.223 ± 0.018
40	84.6 ± 3.7	0.309 ± 0.023
37	64.4 ± 5.8	0.194 ± 0.023
28	68.7 ± 6.6	0.172 ± 0.021
20	71.0 ± 5.7	0.180 ± 0.024
19	76.0 ± 6.1	0.189 ± 0.016
10	61.0 ± 8.0	0.134 ± 0.024

[1] As to series without sodium. In respect of the calculation of the mean errors, see text.

The mean errors of the average dry weights and calcium contents of all harvests for each solution, given in table XIII, have been calculated according to the following method. In order to bring the actual values for each solution and each harvest to a comparable state, they were divided with the average of all solutions for each harvest. An average for each solution of these relative values being calculated, its mean error was calculated according to the usual formula. The relative mean errors were finally recalculated into the absolute values which are given in table XIII, and may be considered to represent a measure of the occasional variation of the point in question in the average curve.

Dry Weight Curves. *Series with Sodium.* The average curve of total dry matter for the series with sodium (fig. 9 *c*) shows a minimum in 82, a maximum 73 to 55, a minimum 46 to 37, and rises from 37 up to a maximum in 19. All the curves for the different harvests (fig. 7 *e*), show two minima and two maxima. The first minima are all in 82, for the second, third and fifth harvest; in 91 and 82 for the sixth; and slightly suggested in 91 for the first harvest. Only the curve for the fourth harvest shows a discrepancy.

Now it must be noted, that in the solution 64 (see table X) only seven plants were alive in the jar of the fourth harvest. This makes it probable that another factor that has had a decreasing effect upon the growth, has been at work in this point. Point 64 of the curve may thus be too low, and this would give a minimum in 82 and 73. Thus, if it were permitted to raise the point 64 in the fourth harvest also, the curve of this harvest should show a minimum in 82 and a maximum between 73 and 55, as the average curve actually shows. If this were so, the average curve would be smoother in these points with a maximum exactly corresponding to that of the average curve of the calcium content (see below).

The curves of total dry matter for all harvests all show a maximum between 73 and 55, except that of the fourth harvest, which is discussed above. The second minimum in the first, fourth, fifth, and sixth curve is situated between 46 and 37, as in the average curve; in the third between 37 and 28; in the second in 55 to 46.

The second maximum, however, in the first curve is in 28; in the second in 37; in the third and fifth curve in 19 — or seems

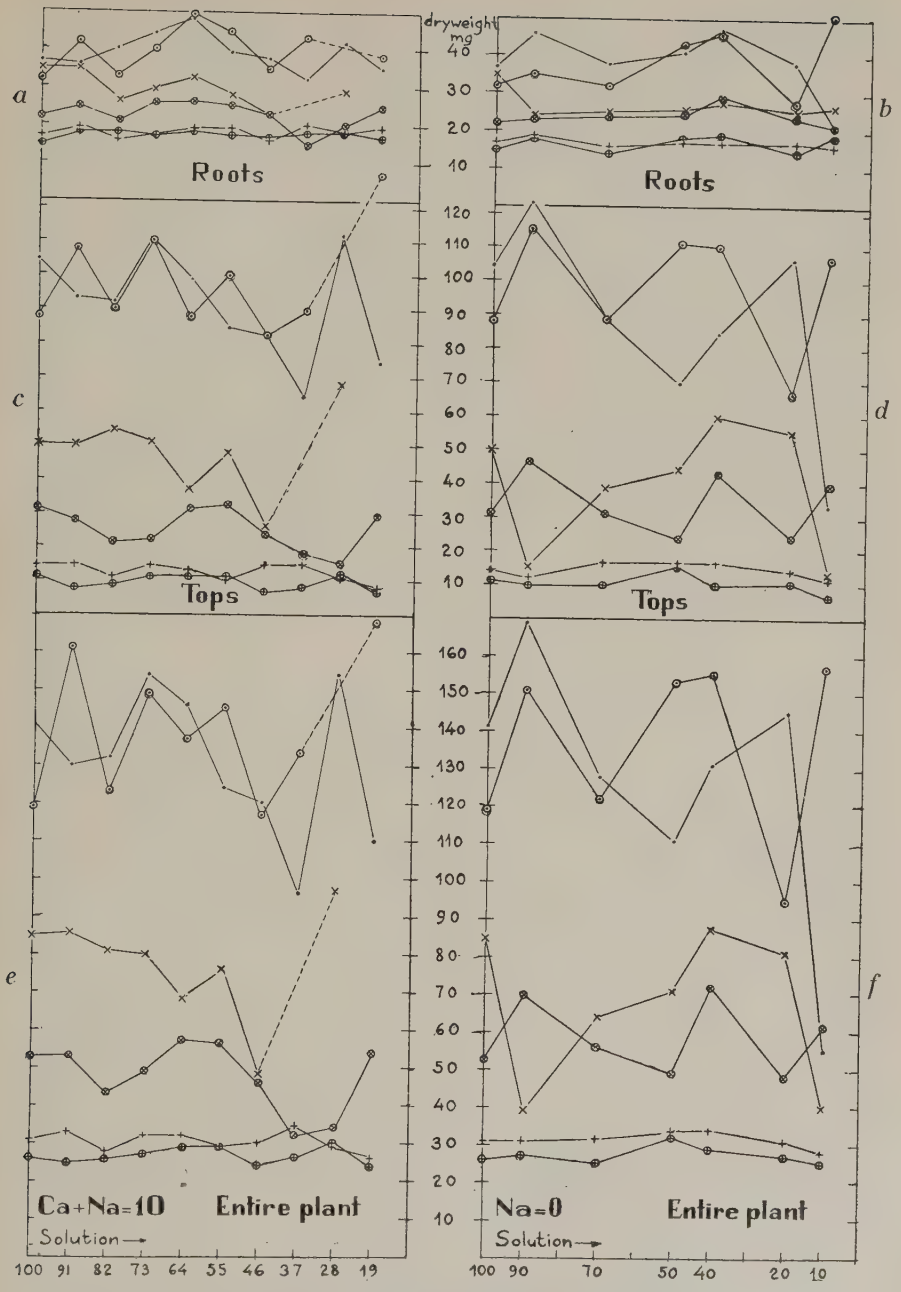

Fig. 7. Relation of dry weight to solutions for different harvests. Experiment 1929.

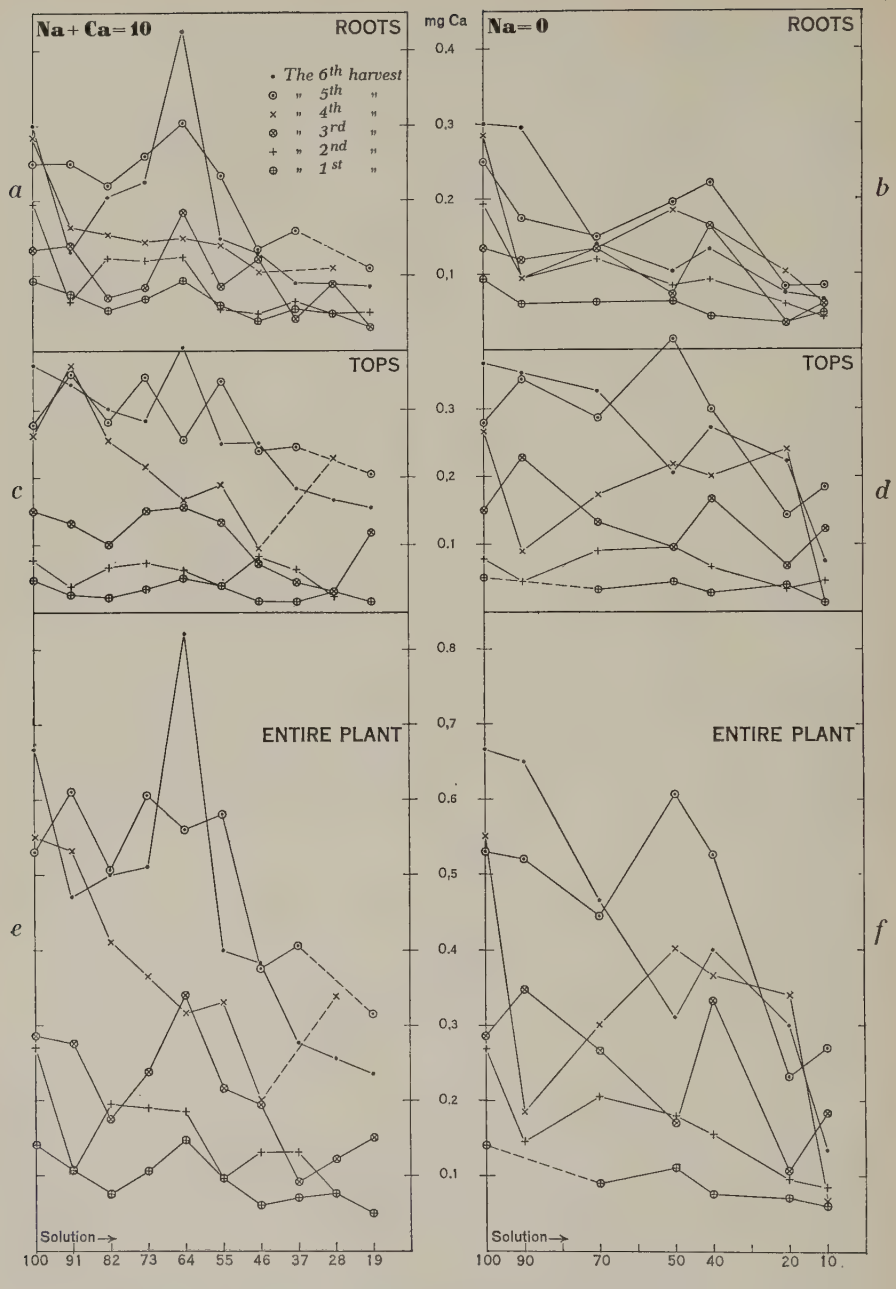

Fig. 8. Relation of calcium content to solutions for the different harvests. Experiment 1929.

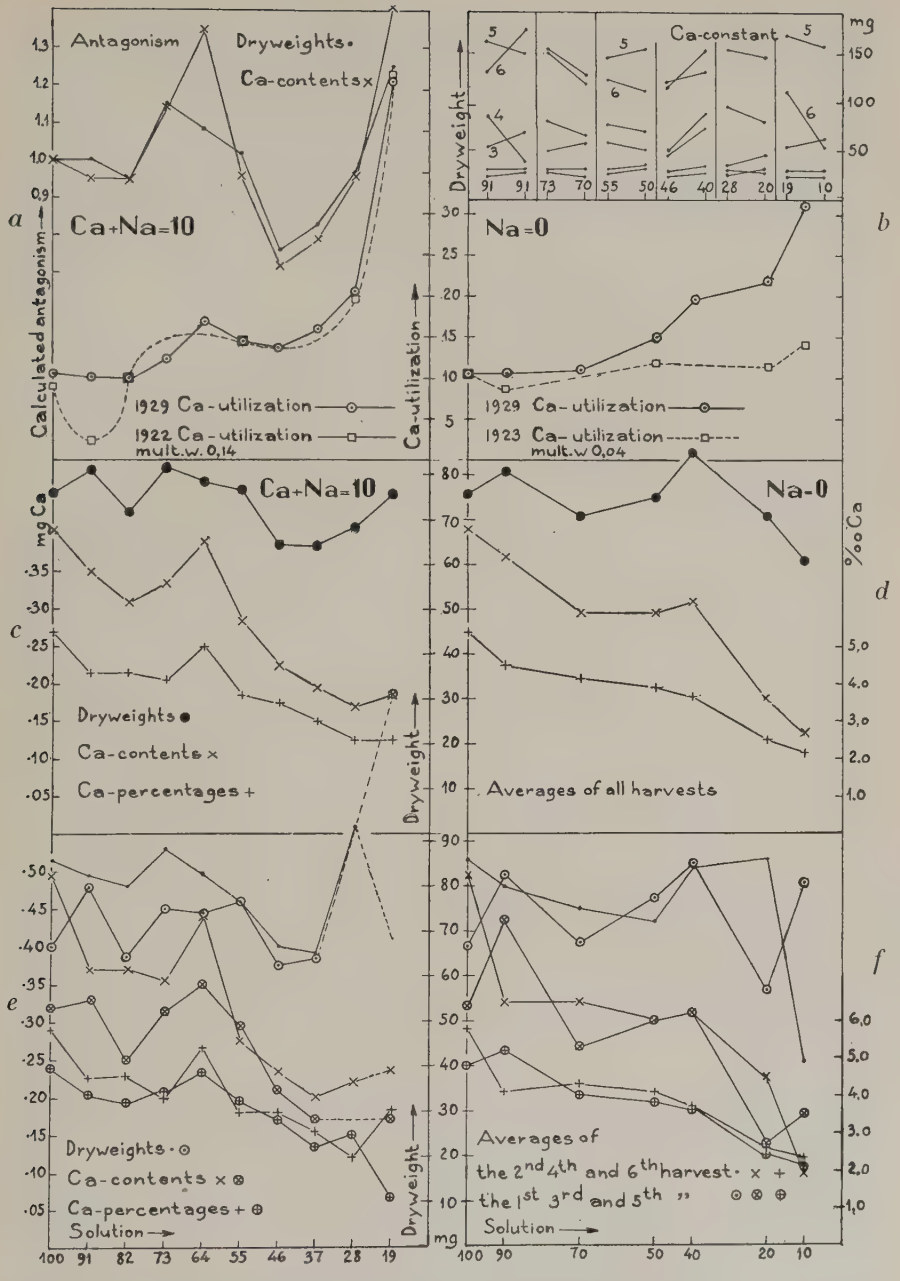

Fig. 9. Relation of average growth, absorption and antagonism to solutions. Utilization curves compared with those of other experiments. Experiment 1929.

to be so, as the point 28 in the fifth was discarded — and in the fourth and sixth curve in 28. This circumstance, compared with the fact that two different lots of seedlings were used for the first, third, and fifth harvest, on the one hand, and the second, fourth, and sixth harvest on the other, seems to point to its dependence upon systematical differences in the two series; e. g. the temperature tended to be higher during the growth of the first mentioned lot. This will, of course, be seen as a difference in this respect between the average curve for the one, and that for the other lot of seedlings, in figure 9 *e*

Finally, the discrepancy between the fifth and sixth curves in point 91 may be due to an unknown error, or may perhaps be explained by a consideration of the matter farther on (p. 213). This discrepancy is also shown by the average curves just mentioned (fig. 9 *e*).

In all other points the agreement between these curves is fairly good. It can thus be summarized that the average curve of fig. 9 *c* gives a good idea of the general features of the curves for the harvests from which it was averaged.

In the curves of the dry weight of roots (fig. 7 *a*) already the first and second curves slightly suggest two minima and two maxima; the third and fourth show the same tendency as the corresponding total curves (fig. 7 *e*), though point 64 of the fourth harvest, which was discussed here before (p. 204), is in the root-curve a maximum point. The root-curves for the fifth and sixth harvests show the maximum more clearly in 64; the most pronounced point of the total curves is in the maximum 73. The second maximum in both curves 37—28, the points for 19 showing a close agreement in the two harvests. The first minimum for the sixth harvest is extended more to the left in the root-curve than in the total curve. The second minimum is in points 37, 46 respectively.

The most interesting feature in the top-curves (fig. 7 *c*) is the discrepancy of the left part of the fourth curve from that of the other curves, in the same direction as the above discussed discrepancy in the total curve. A less marked discrepancy in the total curve of point 64 in the fifth curve is also magnified in the top curve. It looks as if in the solution 64, though optimal for root growth, a decreasing factor of some kind has exercised its influence in the experiments, affecting especially the top growth. This

factor was most accentuated for the fourth harvest; it diminished its effect upon the fifth harvest; and cannot be looked upon as having disappeared in the sixth harvest.

Series without Sodium. The average total dry weight curve (fig. 9 *d*) of the series without sodium shows two maximum in points 90 and 40 respectively, and one minimum in point 50. The curve for the first harvest (fig. 7 *f*) faintly suggests one minimum in 70, maxima at 90 and 50; the second a minimum in 70, maximum at 50 to 40. The third has a minimum in 50, maxima at 90 and 40. The fourth has a minimum in 90 (the number of plants was only three in this point), maxima at 100 (only seven plants) and 40.

The fifth and sixth curves agree only in their left part, both having a maximum at 90. The fifth curve has a minimum in 70, a maximum in 50, and a minimum in 20; and then rises to 10; the sixth has a minimum in 50 and a maximum at 40 to 20; and then drops to 10. This discrepancy cannot very well be explained with occasional errors, for if this were the case more than one point would have to be essentially erroneous. If the curves for the fifth and sixth harvest are compared with those of the third and fourth respectively, it looks as if a difference between the two lots of seedlings, suggested by the form of the third and fifth curve and magnified in the fifth and sixth curve, is the cause of this discrepancy.

It seems nevertheless true that the features common to the curves can be formulated so that a tendency of the curve of dry matter production related to the calcium concentration to form at least one minimum and two maxima, the concentration at which they occur being determined by some uncontrolled factor. The average of the sixth and fifth curve, which is not given in the figure, thus gives a marked minimum at 70 and two maxima at 90 and 40, in close agreement with both curves of the third and fourth harvest.

With these restrictions it seems safe to state that the averaged curve in figure 9 *d* is not contradicted in its essential features by the curves from which it was derived. The discrepancy discussed above, exists of course, though in a less degree between the average curves for the first, third, and fifth harvest, and the second, fourth, and sixth harvest respectively (fig. 9 *f*).

The root-curves of the fifth and sixth harvest have both a tendency to form maxima in 90 and 40, and a minimum in 70

(fig. 7 *b*). They differ only from point 20 to 10. The root-curves of the earlier harvests do not show any regular shape, all the differences being too small for considering this irregularity of any importance. The top-curves (fig. 7 *d*) have all essentially the same form as their corresponding total curves previously discussed. The root- and top-curves thus establish also the existence of two maxima and one minimum of each curve, but the concentration where they occur is dependent on some uncontrolled factor.

Calcium Content Curves. *Series with Sodium.* All the curves for the total calcium content of the series with sodium, with the exception of the fourth, show one minimum and one maximum in the left part of the *xy*-plane (fig. 8 *e*). If the above discussion of the point 64 is taken into consideration, it will be seen that only an increase of the ordinate of this point should impart the same feature to this curve. The first minimum occurs in the first, third, and fifth curve in 82; the minimum of the second in 91; that of the sixth curve in 91 to 73. The calcium content curve generally emphasizes 91 as an unfavourable solution in a higher degree than the corresponding dry weight curve. The maxima are more or less pronounced, occurring in 64. In the right half of the *xy*-plane the earlier curves show a second minimum and maximum corresponding to those of the dry weight curves. These maxima and minima are, however, nearly smoothed out in the curves of the fifth and sixth harvest, and totally wiped out in the average curve for all harvests (fig. 9 *c*). The average curves for the two lots of seedlings agree very well with the minima in 82, and the maxima at 64 (fig. 9 *e*). Finally, the average curve for all harvests is of quite a satisfactory smoothness. It falls off regularly from 100 to 82, and slowly rises to 64, and then falls off evenly to 28, with quite an unappreciable rise to 19. This smoothness, through which the value of each point is emphasized by those of the others, seems to prove that the method of averaging used is permissible, and also the truth of the above discussion of the curves from which this curve was derived.

The root curves (fig. 8 *a*) do not in any essential way deviate from the total curves. But the top-curve (fig. 8 *c*) for the fifth harvest has a minimum in 64. Taking into consideration the previously stated fact, that the decreasing unknown factor of 64 influenced the dry weight of tops in the fifth harvest, this point of the top calcium content curve may be explained in the same way.

Series without Sodium. The total calcium content curves for the series without sodium (fig. 8 *f*) show a minimum and maximum the same as the corresponding dry weight curves. But the discrepancy between the curves of the different harvests referring to calcium content is greater than that referring to dry weight. The fourth and sixth dry weight curves showed a marked maximum between 40 and 20 (fig. 7 *f*); the third and fifth between 50 and 40; the average dry weight curve (fig. 9 *d*) had a maximum in 40, its ordinate lying between those of 100 and 90. The maxima of the fourth and sixth calcium content curves (fig. 8 *f*) have values which are essentially less than those of points 100 and 90. The third and fifth curves do not agree in their form. In the average curve of the second, fourth and sixth harvest the maximum at 40 is very badly marked (fig. 9 *f*), the maximum in the average curve for the first, third, and fifth harvest should be as badly marked if point 70 were to be raised, and may thus be due to occasional errors. If this be true, the tendency of both curves is to decrease monotonously from 100 to 10. The total average curve (fig. 9 *d*) also has slight deviations from a monotonously decreasing form in 70 and 40. Thus the tendency of producing well-marked maxima and minima in the calcium absorption over the variation of calcium in the solution is restricted to the third and fourth harvests, and, in a less degree, to the fifth harvest, which will all be considered hereinafter (p. 214).

The irregularity existing in these curves of total calcium content is also found in the top- and root-curves (fig. 8 *b* and *d*), for which reason a detailed analysis of them will be unnecessary.

Comparison between the two Series in each Point. *Dry Weights.* Fig. 9 *b* (top graph) renders a comparison between the series with and without sodium in each point. The dry weights of the different harvests in 90 and 91 vary irregularly in their relation to each other. The averages for the different lots of seedlings tend both to a slight rise from 91 to 90. The tendency of the average antagonism curve (defined in Philipson, 1924, and plotted in fig. 9 *a*) to form a minimum in 91 is thus only slightly suggested in this experiment. The dry weights of 73 and 70 show a marked tendency in their relation. All curves, with the exception of that of the third harvest, show a decrease from 73 to 70, intensified as time passes. This points to a rise in the antagonism curve from 91 to 73. The dry weights from 55 to 50 tend

to drop from 55 to 50, with the exception of the first, second, and fifth harvest. This drop, however, is in no case so pronounced as that from 73 to 70. All this points to a drop in the antagonism curve. The relation between the dry weights of 46 and 40 is clearly an increase from 46 to 40, intensified with time. This results in a fall in the antagonism curve between 55 and 46. The curves from 28 to 20 indicate a rise from 28 to 20 in the second; a fall in the first harvest, the difference being too small to attach any importance to this irregularity. The third curve gives a rise; the fifth is discarded (see table XI); the fourth and sixth show a fall. This, compared with the curve from 19 to 10, where a rise in the first four harvests and a fall for the two latest harvests, points to the fact that both relations suggest an inversion in the suitability in adding sodium for dry matter production during the first three weeks of growth. As, however, the latest harvests exercise more influence on the average, the antagonism curve must show a rise from 37 to 28 and 19, though this rise may not have a simple form.

The whole comparison between the dry weights of corresponding points of the two series leads us to the conclusion that the »antagonism curve» generally summarizes the relations of the different harvests, though the point 91 is not so strongly intelligible from the different harvest curves. The probable inversion in the relation between 19 and 10, and 28 and 20, cannot be represented in the »antagonism curve», as this curve refers to one averaged fixed time, and the reversion occurs in the course of time. The points 82, 64, and 37 have been calculated on the assumption that the points of the series without sodium, which have been omitted in the experiment, were to be represented by the average between the dry weights of neighbouring points. That the value of 64 is too low, has been suggested before. If we take this into consideration, the antagonism curve is surprisingly smooth, in spite of all restrictions stated before. There is a slight minimum in 91 and 82; a rise up to a maximum, probably in 64; a drop to a minimum in 46 to 37; and a fresh rise up to 28 and 19.

Calcium Contents. The corresponding antagonism curve for the calcium content is plotted in the same graph. It has been arrived at in the same way as the dry weight curve. The relations between the calcium contents of corresponding points of the two series may be considered only for those cases, where this relation

is opposed to the relation of dry weights (see tables). This is the case in the second harvest for the relation 91 to 90. This fact, therefore, imparts greater importance to a minimum of the calcium antagonism curve in 91. The rise to 73 is less accentuated by the relation of the second harvest. The relation of the calcium content in the fourth harvest of 55 to 50 gives more stress to the drop from 73 to 55 and less stress to the drop from 55 to 46. The inversion of the dry weight relations of 28 and 19 becomes less marked for the calcium content in 28 and more marked in 19.

Finally, there is a suggestion of a tendency that an inversion of the calcium content relation is succeeded in the next harvest by an inversion of dry matter production; this holds good for 73 to 70 and 19 to 10, and can be traced also in 91 to 90, and 28 to 20. If this is true, the complexity of the relations of 28 to 20 could be interpreted as follows: The inversion of the dry matter production in the fourth harvest, predicted by the inversion of the calcium contents in the third harvest, may be succeeded by later inversions, predicted by the inversion of the calcium content suggested by the fourth, the rise being pronounced in the sixth harvest.

From the whole discussion it follows that the calcium »antagonism» curve represents the discussed relations with the exception of the inversion of 28 and 19 in their general features. It is in fact even smoother than the dry matter "antagonism" curve. The two curves deviate from each other only in point 64, the deviation of which has several times been referred to above, and in point 19, which must be due to the inversion of the relations at an earlier time for the calcium contents than for the dry weights, as has been explained before.

The inversion stated in 19 for both calcium content and dry weight, and the actual inversion of dry weight in 28 both tend to raise the curve in these points, and the slight tendency of an inversion suggested in 91 tends to emphasize the minimum in this point.

These inversions must manifest themselves by an alteration in the curves of one series in relation to those of the other, in time. Such a variation was, in fact, shown by the calcium content curves in their successive decrease of the right half of the curve, that is more rapid in the series without than in the series with sodium

(cf. *e* with *f* in fig. 8). This decrease in the calcium content curves must be expected — according to the previous discussion — to be succeeded by a later variation in the same direction of the dry weight curves This is actually true, as can be seen from the curves in fig. 7 *e* and *f* comparing the fourth, fifth and sixth curves for each series. The falling off is much less marked in the series with sodium. Expressed in the terms of this discussion, the slight maximum at 40 of the average curve for the calcium contents is to be considered as a belated depression of this point, that may occur later on. Thus the curve will be smoothed out into an approximately straight line known to be the common form of curves expressing the intake of an ion related to its concentration in the solution for longer growth periods (see part IV, p. 179).

The presence of sodium in the solution thus forms a hindrance to this falling off of the right half of the curves. If these processes were to be going on and intensified during the latter part of the growth-cycle, this would result in a more marked maximum of the calcium content curve and the dry weight curve in the presence of sodium. In the absence of sodium it would result in an approach to direct proportionality between the calcium absorption and the calcium concentration, which would be succeeded by a tendency of a monotonous decrease in dry weights with decreasing calcium concentrations in the solutions. This decrease is known from several cultures grown for longer periods of the growth-cycle (compare Philipson, 1924, p. 357). All this should raise the antagonism curves to a well marked maximum in the right half of the curves.

By an analogical analysis, the tendency of inversion from point 91 to 90, there would be explained a sharper minimum in point 91 of the antagonism curve, which will nevertheless not be made, as the inversion in this relation is so feebly suggested. Now it has, in fact, been proved in a previous part (see part IV, fig. 4 *c*) that the principal features of the antagonism curves for longer periods are a pronounced maximum in points 19, and a sharp minimum in 91. This has also been proved in part VII for mature plants. It may be noted that Shive and Martin observed alteration with time in the optimal ratios for the growth of buckwheat (1918).

Calcium Utilization. Finally, the curves for the utilization of calcium, i. e. the calcium absorption of each solution divid-

ed by the amount of calcium present in 100 cc. of the solution, have been plotted in figure 9 *a* and *b*. The calcium absorption is calculated from the calcium content of each point by diminishing it by 0.022 mg., the aforesaid value of the content of the seed and seedling at the time of plantation. These curves are very smooth. The one for the series without sodium shows only slight deviations from the simple form that should represent the course of the curve, if the curve of calcium contents were to be a straight line, as suggested above. The curve of the series with sodium shows the tendency to rise according to a line of the same form, but with a higher value for the terminal point. From this line, however, the curve shows essential deviations — supported by the smoothness of the curve, and the corresponding curves of the different harvests — in points corresponding to the maximum and minima of the calcium content curve. A comparison between this curve and the corresponding curve of the previous experiment with longer periods of growth is made in fig. 9 *a*. In this figure the scale for the ordinates of 1922 have been multiplied by 0.14, which is the approximate ratio between the volumes of solutions that have been available for each plant in the two cases. From this comparison it is clear that point 91 of 1922 deviates essentially from the corresponding point of 1929. All the other points of 1922 agree remarkably well with the curve of 1929 for the series with sodium. The difference in 91 indicates the tendency of falling off in 91 during later stages of growth, producing a more marked minimum in this point.

As the experiments of 1922 did not contain results from the solutions 73, 64, 46 and 37, the maxima and minima of these points have not been established as existing also in the curve of longer periods of growth. The curve from 1922 constructed only by connecting the actual values of the points investigated, forms sharp discontinuities which have been smoothed out in the simplest possible way in the curve plotted in the figure concerned. This curve agrees very well with the curve of 1929. It is probable that this curve really represents the true relation in question.

The graph also affords the chance of comparing the antagonism curves with the calcium utilization curve. The agreement with the antagonism curve is fairly good from 100 to 64. After 64 the utilization curve rises much more rapidly than the antagonism curves.

Now it has previously been stated (part IV, p. 187) that the calcium utilization curve in 1922 agrees very well with the antagonism curves of the same year. From this it was concluded that a close relation exists between the antagonistic effect upon dry matter production and calcium utilization in so far as longer periods of the growth-cycle were concerned. Now it follows from the similarity of the calcium utilization curves of 1922 and 1929, that the antagonism exercises an influence upon the plants already from the beginning of the vegetation period, although the toxic effect of the solution 91 only exercises a minor influence on this early growth.

This early antagonistic effect, shown by the calcium utilization curve, has no close relation to the calculated "antagonistic effect" in this period for the right half of the *xy*-plane. The maximum of this part of the antagonism curves is relatively not so high as that of the utilization curve. All this suggests the following statements: The antagonism between calcium and sodium, in the widest sense of the word, must depend on two different processes. Both affect the utilization of the calcium concentration of the solution and the relation of dry weights and absolute values of calcium absorption to the corresponding values of solutions, where sodium is omitted.

One process predominates in solutions containing less than 6 calcium. This process affects the calcium utilization curve during the first three weeks of growth, making this early utilization curve conform to that of the longer period. It also affects the early "antagonism curve", in the same sense, but to a far less degree. The close relation between calcium utilization and antagonism for longer periods of growth must thus be a causal relation, where the calcium utilization is the primary factor, as far as this first process is concerned.

The other process does not make the early utilization curve conform to the curve of longer growth periods, but it affects the early curve in the same sense, though to a less degree than that of a longer growth period. A close relation between the actions upon calcium utilization and antagonism of this process was found for both early and later curves. It cannot safely be stated, which factor of this relation is to be considered as primary, but

a suggestion in favour of the calcium utilization is found in the different harvest curves of the calcium contents (fig. 8) compared with those of dry weights (fig. 7). The calcium content curves show all (with the exception of the fourth, discussed above) a sharp minimum at point 91 or 82; the dry weight curves, however, have a less marked minimum in either of these points in the first to fourth harvest, the sharp minima occurring firstly in the fifth and sixth harvest. As the toxic effect upon the calcium absorption is thus primary to that on the dry matter production in these solutions, it is probable that also the effect on the calcium utilization curve is primary to that on the antagonism curve of dry matter production. The second process must be intensified in its action upon both these related phenomena during later stages of plant growth.

This conclusion of two processes causing the differences in calcium utilization is also well expressed by the terms of the calcium contents, as is shown by the average curve in fig. 9 *c*. Furthermore, the types of the calcium content curve over time in their relation to the concentrations of the solutions (fig. 6 *d*—*e* and p. 201), show an alteration in point 64.

A comparison between the utilization curves for the series without sodium of 1929 and 1923 respectively can be made in fig. 9 *b*. The ordinates of 1923 have been multiplied by 0.04, representing the approximate ratio between the volumes of nutrient solutions available for each plant in the two experiments. The curves agree only in point 100, and the rise of the 1929 curve is much more rapid than that of 1923, which is quite insignificant. This points to the fact that the nutritive effect of calcium is intensified during the time of growth, as has been stated before.

Relation of Dry Weight to Calcium Content. A comparison between a calcium content curve with its corresponding dry weight curve, in each case manifests an agreement between them with certain limitations. This, demonstrated on the average curves of figure 9 *c*—*d*, shows for the series with sodium that the maximum 64 and minimum 82 of the calcium content curve possess points of close agreement in the dry weight curve, if it is taken into consideration that the dry weight of 64 must be too low. The slight rise from 28 to 19 in the calcium content curve corresponds to an essential rise in the dry weight curve.

The well-marked maximum in 40 and minimum in 10 of the dry weight curve for the series without sodium correspond to slightly suggested extremes in the calcium content curve. And if the different harvest curves (fig. 7 and 8) are taken into consideration, it is found for the third and fifth harvest that the dry weight maxima are to the left of 40, the calcium maxima being well marked; for the fourth and sixth harvest (i. e. for the other lot of seedlings) the dry weight maxima to the right of 40, the calcium maxima being less marked. All this points to the following conclusion: The maxima and minima in the left half of the xy-plane, i. e. in the higher calcium concentrations, are connected with a respectively higher and lower intake of calcium. The maxima in the right half of the xy-plane, i. e. in the lower calcium concentrations, are connected with better economy with the calcium amount absorbed, as far as dry matter production is concerned. This is true for both series; one with and the other without sodium.

This will also be seen by the curves for the percentage of calcium in relation to the dry weight plotted against the solutions. These curves have been averaged in fig. 9 *c*—*d*. The percentage curve for the series with sodium shows a minimum in 91 to 73 and a maximum in 64, and then falls off regularly; though the maximum of 64 is here not so well borne out as in the previous cases, in fact, it is probably, from the conception of the dry weight as being too low in this point, that the point 64 of the percentage curve is too high. The curve would thus be uniformly decreasing, as is the case with the series without sodium. The same form was found in the percentage curves of 1922 and 1923 resp. (see part IV, fig. 2 *c*), except the minimum of 91. This decrease in the right half of the xy-plane also shows a better economy with the absorbed calcium.

In part IV the dry weights were also plotted directly against the calcium absorption, which showed a form that leads to the suggestion of an internal action (p. 186). The corresponding curves for this experiment are even more complicated than the other curves previously discussed, and the variation between the harvest curves is very great, wherefore an analysis of them will not give any clearer conception of the phenomena than was reached above, and therefore the author refrains from recording them.

Final Considerations. The differences between the series with and without sodium during the early growth have to be considered here. The average dry weight curves of both series (fig. 9 *c*—*d*) have two maxima. The series with sodium in points 73 to 55 and 28 to 19; the series without sodium in points 90 and 40. The differences may therefore be expressed as a tendency of the presence of sodium to displace the maxima into solutions with less calcium.

The calcium content curve of the series without sodium was tending to a straight line with the increase of growth in the course of time, the curves of the earlier harvests had marked maxima and minima; the later harvests smoothed them out successively; the curve of 1923, for 2 months' growing, was a straight line (see part IV, p. 179). This difference between the earlier and later part of growth was also demonstrated by the comparison between the calcium utilization curves of 1929 and 1923 (see above p. 217).

All this points to a similar, but not identical, effect as the antagonistic effect in the series with sodium, analysed above, which should have been exercised during the very early growth in the series without sodium. This effect is smoothed out first in the calcium content curve, i. e. the right half of the curves drop, successively tending to a sloping straight line, as has been established before. This smoothing out of the curve means a decreasing calcium absorption with decreasing calcium concentrations of the solution, which is the principal feature, by which a nutritive effect must be recognized. The nutritive effect is thus counteracted by the effect of another kind during the very early growth in the series without sodium. Already after the first three weeks the nutritive effect is dominant as far as the calcium absorption is concerned.

Later on during the vegetation period this will cause a smoothing out of the dry weight curve to produce the smooth logarithmical form (compare p. 214). In 1923 the curve of dry weight was very nearly smoothed out, but even there, after two months' growth, an irregularity was found in the left part of the curve (see fig. 2 *f* and p. 179, cf. also p. 233).

In summarizing these conclusions it has been demonstrated in the series without sodium that the nutritive effect

dominates all other actions of the varied calcium concentrations from an early stage of growth. In the series with sodium the antagonistic action is at work throughout the vegetation period. This antagonistic action has been analysed above. But that also a nutritive effect is exercising an influence in this series, is clear from the fact that also the different harvest curves of the calcium content showed a tendency to drop in the right half of the *xy*-plane, as was stated above (p. 210). This slope in the curve of the calcium content is also demonstrated in the experiment of 1922 (part IV, p. 181). This established the conclusion reached in the 1924 paper by the author (p. 367).

VII. EXPERIMENTS 1924, 1925 and 1926.

1. **Arrangement of Cultures.**

The continuous flow of solution was obtained by a method described by Allison and Shive (1923). The 10-litres storage flasks were held inverted by a wooden stand. The two holes in their rubber stoppers were fitted with glass tubes, which dipped into a glass jar, their bottom edges projecting unequally far into it. The surface of the solution in this glass-jar was thus kept at a constant height. These wooden stands were fixed direct to wooden benches, each of them supporting five culture jars. From the constant-level jar the solution was siphoned into a branching tube with five capillary outlets, which were inserted into tubes passing to the bottom of the culture jars, by the aid of corks, with holes large enough to permit of communication with the outer air. The length of the capillary tubes was regulated and controlled daily, so as to give a constant flow equal for all the culture jars.[1]

The benches were placed in the direction of the meridian, with the stand at the northern end so as to avoid its shading influence

[1] During the 1924 experiment an accident occurred to the investigator, which forced him to discard the continuous renewal of solution for the last half of the growth-period. Instead of that 300 cc. of the solution were added daily to the bottom of each jar. The difference of this treatment cannot be determined. Compare, however, Hoagland (1919, p. 85) who was able to state that the concentration during the last part of the growth-cycle, exercised no influence on the growth.

upon the cultures. The plants were supported by soft cotton strings fastened at one end to the stand and at the other to thin wooden supports. The solution of the storage bottles was replenished, when necessary, after mixing for each calcium concentration in 60 litres carboys, the addition of sodium being made directly into the storage bottles, which for the purpose of proper mixing were removed from the stands.

The plants in each jar were allowed to grow until they had reached maturity. This was attained in all except a few jars, which were discarded.

2. Results of 1924 Experiment.

In the 1924 experiments sixteen solutions close to 91 (the minimum point of 1922) in figure 1 were selected for investigation.[1] When transferred into the solutions the seedlings were 20 days old. The time of growth varied between 93 and 113 days. The results are given in table XIV and figures 10 and 11.

Dry Weight Relations.

Calcium Constant (*c*). The variation in growth with variation in sodium concentration and calcium concentration constant within each series will first be taken into consideration. For Ca = 10 the seed curve as well as the seed + straw curve show an increase from Na = 0 to Na = 2; a decrease to Na = 3. For Ca = 9 these relations are inversed, the curves forming minima at Na = 2. For Ca = 8 the same form occurs, though less pronounced, and for Ca = 7 the curve finally has a monotonous increase from Na = 0 to Na = 3.

Sodium Constant (*b*). *Dry Weight Curves.* The variation with calcium concentration for constant sodium concentration will be considered next. For Na = 0 the curves of seeds and straw + seeds show an optimum at Ca = 8 and Ca = 9 respectively. It seems as if in this case the optimal concentration of calcium is less than 10 in opposition to the experiment of 1923, which may be due to extremely serious occasional errors. According to the great differences in dry weights of solutions 100

[1] Another set of sixteen solutions near 19 (the maximum point of 1922) was also started, but this part of the experiment had to be discarded.

Table XIV. **Experiment of 1924. Averaged values.**

Solution	Harvest	Number of plants	Number of tillers	Length of longest shoot	Dry weight pr plant gr.	
					Straw + seeds	Seeds
100	$^{30}/_{9} \pm 0$	28	6.5 ± 0.8	91 ± 9	7.03 ± 0.97	1.23 ± 0.42
101	$^{6}/_{10} \pm 3$	30	6.3 ± 0.7	93 ± 3	7.90 ± 1.34	1.83 ± 0.37
102	$^{9}/_{10} \pm 3$	28	9.1 ± 0.8	104 ± 3	10.38 ± 1.22	1.91 ± 0.30
103	$^{12}/_{10} \pm 3$	26	6.8 ± 0.7	102 ± 3	8.05 ± 1.11	1.47 ± 0.15
90	$^{18}/_{10} \pm 1$	26	8.6 ± 0.5	104 ± 4	11.05 ± 0.61	1.80 ± 0.21
91	$^{12}/_{10} \pm 3$	26	7.2 ± 0.6	93 ± 16	7.62 ± 0.95	1.28 ± 0.13
92	$^{14}/_{10} \pm 2$	26	6.5 ± 0.8	79 ± 3	6.04 ± 0.95	1.10 ± 0.14
93	$^{14}/_{10} \pm 3$	24	6.8 ± 0.6	96 ± 5	9.48 ± 1.41	1.62 ± 0.21
80	$^{20}/_{10} \pm 1$	26	7.5 ± 0.7	98 ± 5	9.60 ± 1.58	1.93 ± 0.37
81	$^{8}/_{10} \pm 2$	28	5.9 ± 0.3	111 ± 2	8.48 ± 0.65	2.34 ± 0.21
82	$^{29}/_{9} \pm 0$	28	4.3 ± 0.4	91 ± 4	5.88 ± 0.52	1.87 ± 0.17
83	$^{29}/_{9} \pm 0$	30	5.8 ± 0.4	96 ± 3	6.76 ± 0.53	2.35 ± 0.16
70	$^{20}/_{10} \pm 3$	27	8.2 ± 0.7	91 ± 3	7.67 ± 1.01	1.22 ± 0.15
71	$^{9}/_{10} \pm 2$	28	7.5 ± 0.4	98 ± 3	8.04 ± 0.84	1.38 ± 0.14
72	$^{7}/_{10} \pm 1$	28	9.0 ± 0.8	107 ± 2	8.38 ± 0.63	1.50 ± 0.12
73	$^{19}/_{10} \pm 2$	24	9.8 ± 0.9	103 ± 4	12.06 ± 1.59	1.82 ± 0.20

and 90, however, it must be considered that the concentration 10 of calcium was supra optimal under the conditions of this experiment; it should also be mentioned that the time of growth in this solution was short (see below). For Na = 1 the differences are not very great in the dry weights of straw + seeds; the curve of the seeds has one maximum in Ca = 8, and one minimum in Ca = 9. The relations for Na = 2 enhance the importance of the minimum of this point for both curves. For Na = 3 a maximum growth of seeds is attained in Ca = 8; and for straw + seeds in Ca = 7. All these relations for Na constant as well as for Ca constant can be summarized thus that the curves over the square in figure 1, which limits these solutions, pass through a minimum if the abscissæ represent lines which pass the inner surface of the square; and through a maximum if their corresponding lines constitute the edges of the square.

Antagonism Curves. If the calculated antagonistic effect is taken into consideration as to its relation to the calcium concentration

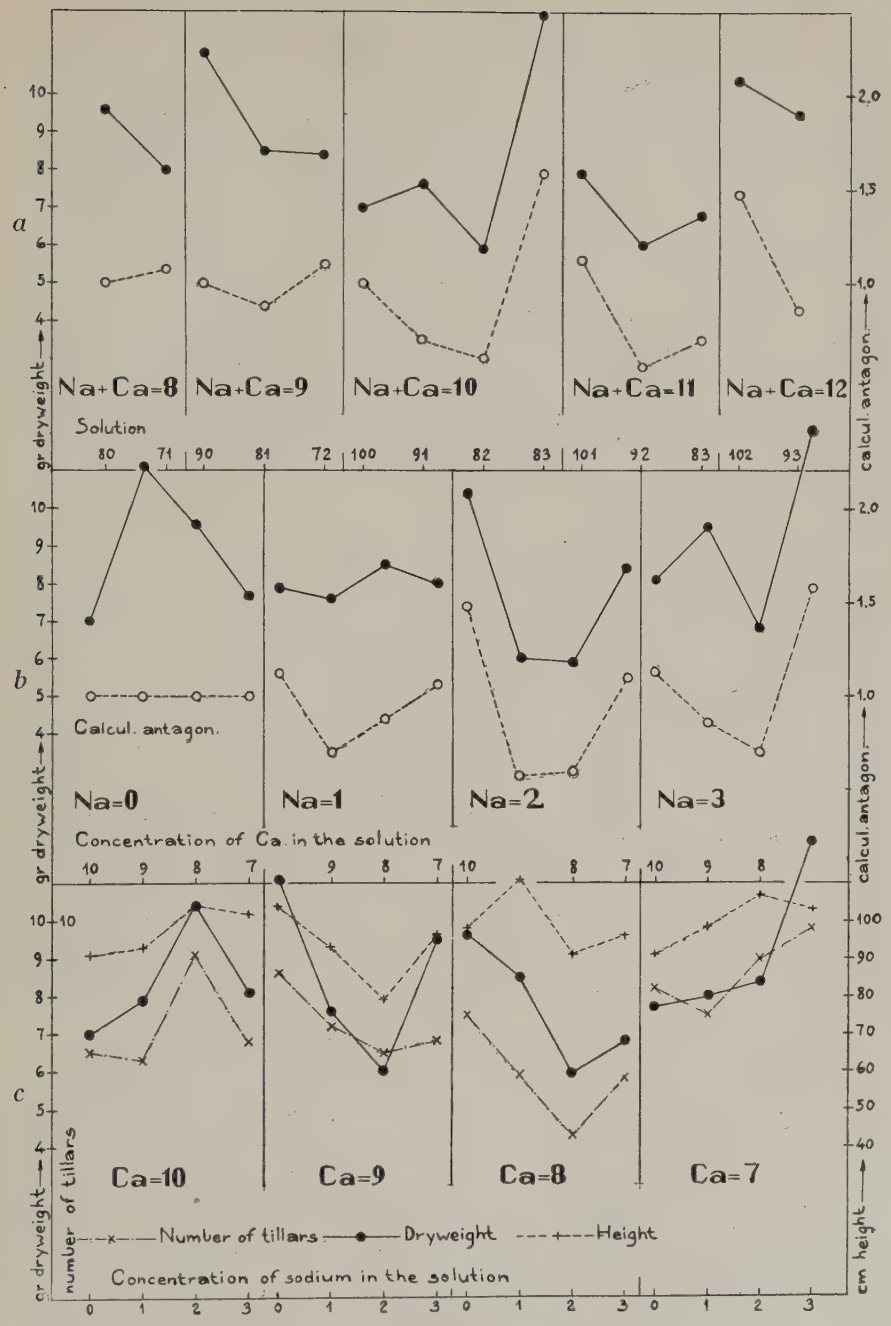

Fig. 10. Relation of dry weight, antagonism, height and tillering of mature tops to solutions. Experiment 1924.

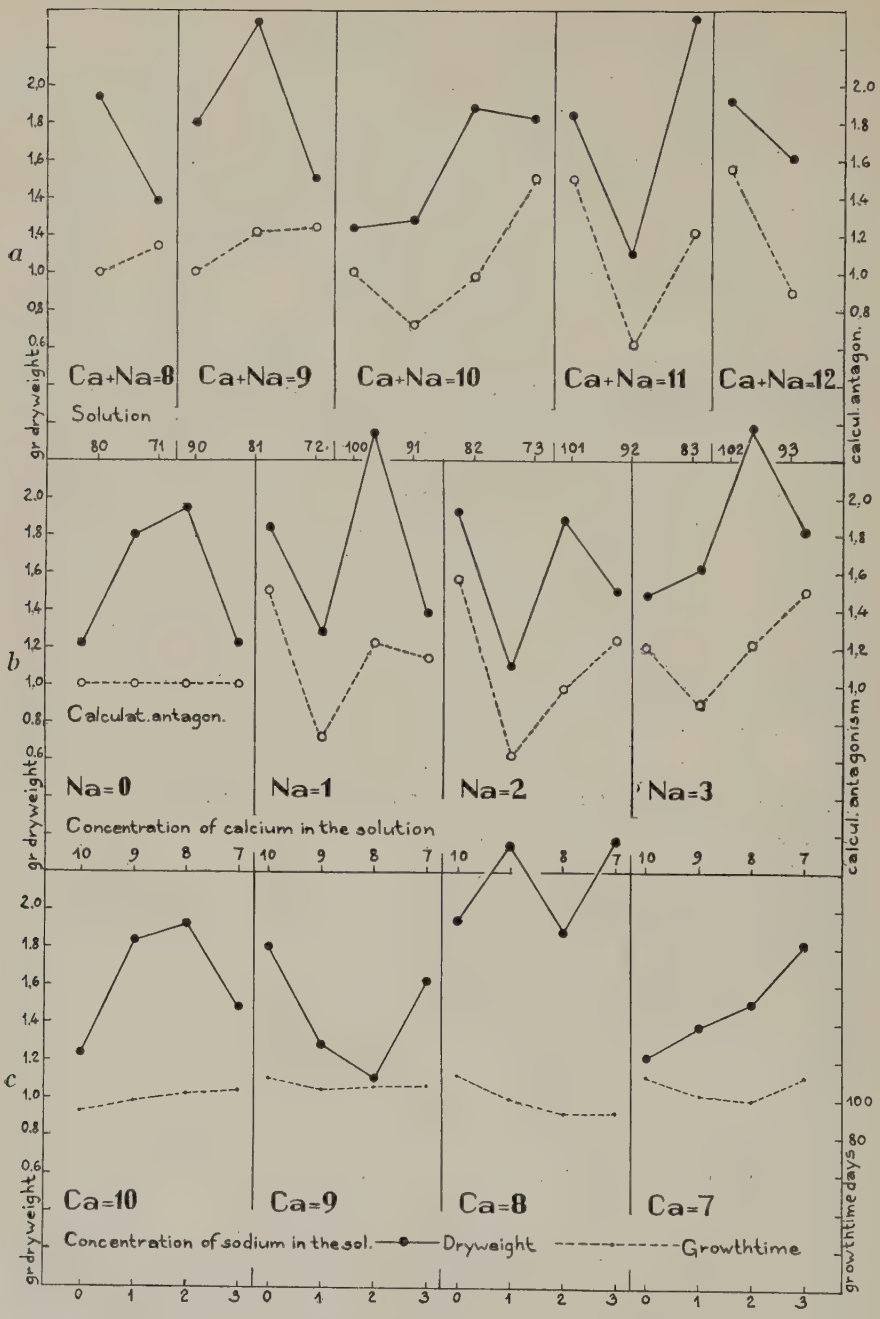

Fig. 11. Relation of dry weight and antagonism of seeds and growth time to solutions. Experiment 1924.

within the set of curves with constant sodium concentration this relation is much more easy of interpretation than that of the dry weights. Thus, the curves have all a minimum point (except of course for Na = 0, where according to the definition the antagonistic effect is unity in all concentrations); this minimum gradually and very smoothly increases its prominence from Na = 1 to 2, and has a slightly decreased influence in Na = 3. In fact, the three antagonism curves for each seeds and straw + seeds alter their form gradually with increasing sodium concentration.

That the antagonism curves thus represent a simpler relation to the varied concentrations of the solutions, is well understood, if the idea with the calculation of the antagonism curves is taken into consideration. As has been stated before (p. 220 and PHILIPSON, 1924), the nutritive effect of calcium cooperates with the antagonistic effect of the salts, as far as the actual growth in each solution is concerned. If we consider this nutritive effect to be represented by the curves of dry weight for Na = 0 and the combined effect by the other dry weight curves, the antagonism curves should represent the other component of the dry weight curves. Thus, these antagonism curves must demonstrate simpler relations than the dry weight curves if the foundations of the calculations are approximately correct. And as simpler relations have been proved for the antagonism curves, the analysis must be considered to have further proved the soundness of the method of calculation. (Compare part IV, p. 189 and PHILIPSON, 1924, p. 364.)

If the antagonistic effects were plotted against the proportion between sodium and calcium actually present in the solution, an oscillating curve should be obtained with maxima and minima, changing alternately. Such a relation to the ratio between potassium and calcium actually present in dilute solutions, which did not contain any further cations, has been demonstrated for root growth in cultures of brief duration by HANSTEEN [CRANNER] (1910, p. 333). As was shown in part VI, in the earliest period of plant growth the nutritive effect exercises a much smaller influence upon the growth than the antagonistic effect (p. 219). This statement can thus be applied to HANSTEEN's brief cultures, and, moreover, the antagonism between potassium and calcium has operated undisturbedly by the balance to other ions, as his solutions contained no other cations. The agreement between the aforesaid oscillating curves will thus be well understood in terms of the

above discussion of the calculation of the antagonistic effect, provided sodium and potassium are assumed to have a similar influence on the general tendency of the relation in question, which is very probable, since the antagonistic effects of potassium and sodium are very similar, as has been found by OSTERHOUT (1909). Cf. also LUNDEGÅRDH and MORAVEK (1924, p. 307), who found oscillating curves for absorption in cultures of short duration, NIKLEWSKI with collaborators (1928, p. 108) and LEMAŃCZYK (1926, p. 1149).

Calcium + Sodium Constant (*a*). The upper row of figures 10 and 11, represents the dry weights in relation to the series with a constant sum total of calcium and sodium concentration. The curves of the graph in the middle of each row thus correspond to the left part of the dry weight curve and antagonism curve of 1922 (part IV, fig. 2 *e* and fig. 4 *c* respectively).

The successive alteration of the curves from left to right is also here more pronounced in the antagonism curves. This successive alteration with the variation of the parameter of each row of the figure must be considered as a support for the values recorded, which is just as good as a smooth form of one curve usually constructed in the plane. Though, therefore, only four points are considered in each graph, the combined consideration of all graphs enables each graph to be dealt with, as if it were supported by more points than four. The establishment of 91 as a minimum in the graphs Ca + Na = 10 is thus supported by the whole series Na + Ca constant, and the other series of graphs too.

It is also proved by the graphs Na + Ca constant that all points in figure 1, which do not belong to the edges of the square representing the solutions under consideration, represent inferior solutions for the growth of oats up to a ripe state. Such limited areas in the representation of solutions over which inferior growth occurs, were also found by TOTTINGHAM (1914, compare fig. 10, p. 215 and fig. 4, p. 195, $T_1 R_2 C_5$ and neighbouring points). Over such areas, consequently, the solid figures, forming the complete representation of the growth and antagonism of all solutions under consideration, would display depressions on all sides surrounded by elevations of its surfaces, if they were constructed.

Other Measurements.

Height and Tillering. In the lower row of fig. 10 the height of the plants and the number of tillers have also been

plotted in relation to the same abscissa as the dry weight. In all four graphs the number of tillers varies in the same sense as the dry weight, although the differences are not always so well marked. The agreement between the height curves and dry weight curves is not so good. In these solutions a correlation between especially the number of tillers and dry weight thus exists, as far as mature plants are concerned. Such a correlation may also be suggested by table V, p. 176, though not quite so pronounced. In the experiment 1923 B, however, the variation in dry weight did not seem to be correlated with the number of tillers and height (see p. 193). In the latter instances the growth periods were shorter, respectively two months and forty one days.

This might, perhaps, point to a correlation between the dry weight production, tillering, and height during the later periods, but the experiments discussed are not comparable, as the limits within which the concentrations varied were essentially dissimilar in the three years concerned. Moreover, the material was not sufficient to permit of any safe conclusions. These correlations thus call for further experiments to investigate them under different conditions.

Variation in Growth-Period. As the plants in each jar were allowed to grow to maturity, a slight variation in the growth-period has also to be considered. This has been done in the lower row of figure 11. The differences are all very small, and very slight correlation with the trend of the variation in the dry weight curves of the same graphs and the one of the lower row in figure 10, are only found in odd points. It must, however, be noted that also the growth time curves tend to gradually alter in form, with the variation in the parameter of the series.

3. **1925 and 1926 Experiments. Straw + Seeds.**

In these experiments solutions were chosen which are represented by points in the neighbourhood of 19 in figure 1, which proved to be the optimal point in 1922. The results are given in tables XV and XVI.

Calcium Constant. The relation of the dry weight of straw + seeds to the variation of the sodium concentration at constant calcium concentration has been plotted in fig. 12. The graphs of the lower row (*e*) contain only two points each, one corresponding to

Table XV. **Experiment of 1925. Averaged values. Dry weight pr plant. Straw + seeds.**

Solution	Number of plants	Grammes
100	30	4.44 ± 0.43
80	30	4.50 ± 0.36
82	30	4.00 ± 0.43
60	30	3.60 ± 0.24
64	29	4.16 ± 0.29
40	29	3.30 ± 0.23
46	30	4.20 ± 0.25
48	29	4.90 ± 0.38
4.10	29	3.13 ± 0.21
37	30	4.77 ± 0.40
39	30	3.97 ± 0.27
20	30	3.52 ± 0.27
26	30	3.90 ± 0.29
28	30	3.78 ± 0.23
2.10	29	3.85 ± 0.26
17	18[1]	4.59 ± 0.58
19	30	3.82 ± 0.28
0.6		0.27 ± 0.06[2]
0.8		0.20 ± 0.03[2]
0.10		0.23 ± 0.02[2]

[1] Two jars discarded because of breakage.

[2] The plants from one jar of each series were weighed separately. The plants from each of the other jars of the series were weighed together. The mean error is calculated on the assumption that the variation was the same in these other jars as that determined by the separately weighed plants.

a point on the x-axis; the other on the line 100 to 0.10 of figure 1. In Ca = 9, 8 and 7 there is a decrease in these curves, in Ca = 6 and 5 an increase. The change from decrease to increase occurs, thus, in Ca = 7—6. This change was also obtained in the curves of 1924 (see above), but it occurred there in Ca = 8—7. It must therefore be considered as established that the change in the slope of the curves will take place somewhere between Ca = 8 and Ca = 6.

Table XVI. **Experiment of 1926. Averaged values.**

Solution	Harvest	Number of plants	Dry weight pr plant gr.	
			Straw + seeds	Seeds
100	$^{21}/_{8}$	18	9.68 ± 0.79	3.72 ± 0.32
90	$^{22}/_{8} \pm 1$	29	9.04 ± 0.53	3.03 ± 0.23
91	$^{21}/_{8}$	29	7.44 ± 0.80	2.31 ± 0.25
70	$^{21}/_{8}$	18	8.90 ± 0.82	2.82 ± 0.33
73	$^{22}/_{8} \pm 1$	30	8.08 ± 0.64	2.94 ± 0.31
50	$^{28}/_{8} \pm 5$	29	6.87 ± 0.80	2.12 ± 0.29
55	$^{26}/_{8} \pm 2$	27	8.27 ± 0.91	2.27 ± 0.27
30	$^{24}/_{8} \pm 3$	29	5.43 ± 0.68	1.56 ± 0.23
37	$^{23}/_{8} \pm 2$	30	6.55 ± 0.72	1.77 ± 0.22
38	$^{21}/_{8}$	24	7.34 ± 0.67	2.39 ± 0.25
27	$^{21}/_{8}$	24	4.92 ± 0.41	0.88 ± 0.10
28	$^{21}/_{8}$	24	7.69 ± 0.58	2.95 ± 0.25
29	$^{21}/_{8}$	30	6.05 ± 0.61	1.23 ± 0.18
2.10	$^{21}/_{8}$	28	6.37 ± 0.80	1.88 ± 0.28
10	$^{21}/_{8}$	29	5.94 ± 0.48	1.23 ± 0.10
17	$^{24}/_{8} \pm 3$	30	6.23 ± 0.47	1.48 ± 0.17
18	$^{21}/_{8}$	30	6.38 ± 0.54	1.66 ± 0.15
19	$^{26}/_{8} \pm 5$	29	4.74 ± 0.42	0.97 ± 0.11
1.10	$^{23}/_{8} \pm 2$	30	5.88 ± 0.56	1.45 ± 0.18
0.10	$^{21}/_{8}$	25	1.22 ± 0.15	0.03

The curves for Ca = 4 to Ca = 1 show good agreement in the relation between the dry weights of the two years in all points which could be compared, except in the latter part of the curve of Ca = 2, where the 1925 curve is represented by a broken line. An agreement between the curves should have existed if in 1925 the solution 27, which was not investigated in that year, had produced a superior growth to that of 28 and 26. If this were true, the 1925 curve for Ca = 2 should not only have been in approximate agreement with the 1926 curve for Ca = 2, but also the successive alteration in the curves from Ca = 4 to Ca = 1 with the parameter should be very smooth. With this restriction we may conclude that all the curves have a maximum in Na = 8. In table XV also the points of the series Ca = 0 can be compared. Within

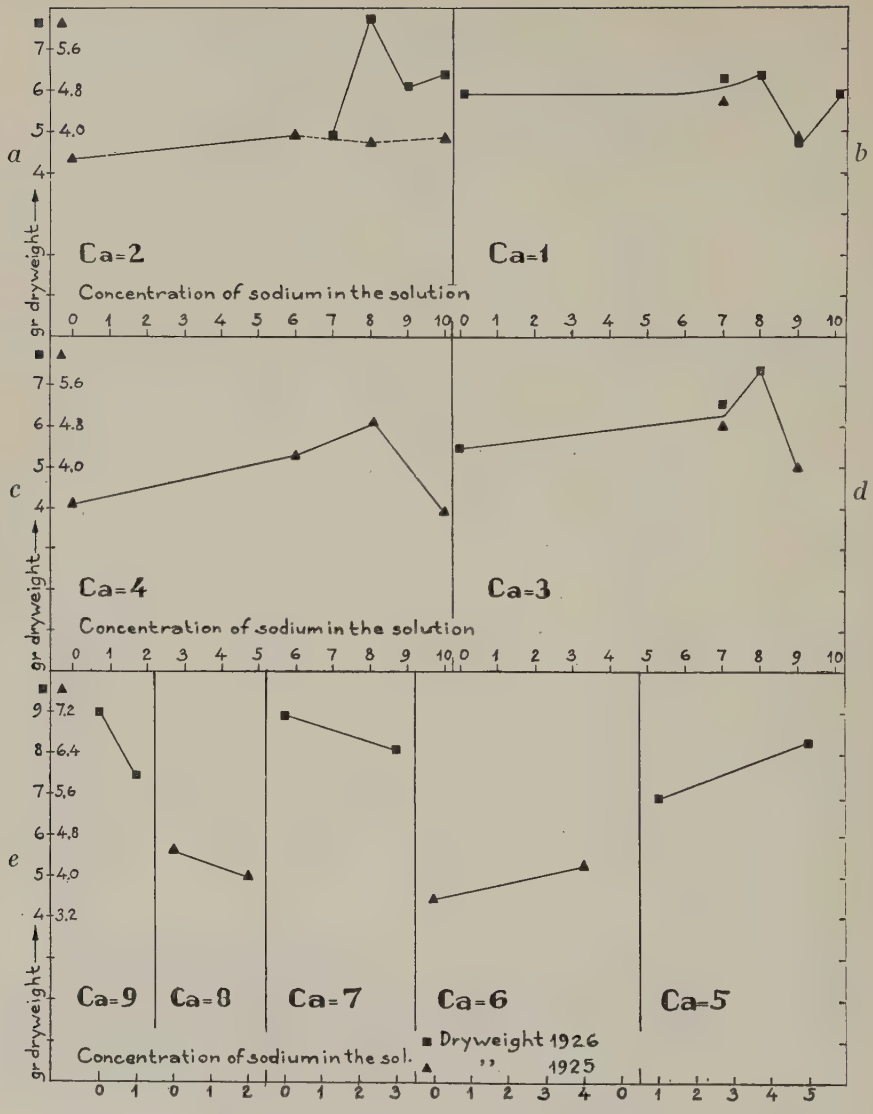

Fig. 12. Relation of dry weight of mature tops to solutions. Series Ca constant. Experiment 1925—1926.

the limits of the experimental errors the variation of the amount of sodium from 6 to 10 does not affect the growth when calcium is absent.

Sodium Constant. Both the curves of the series Na = 0 take the same course (see fig. 13 *c*). In both a slight rise in

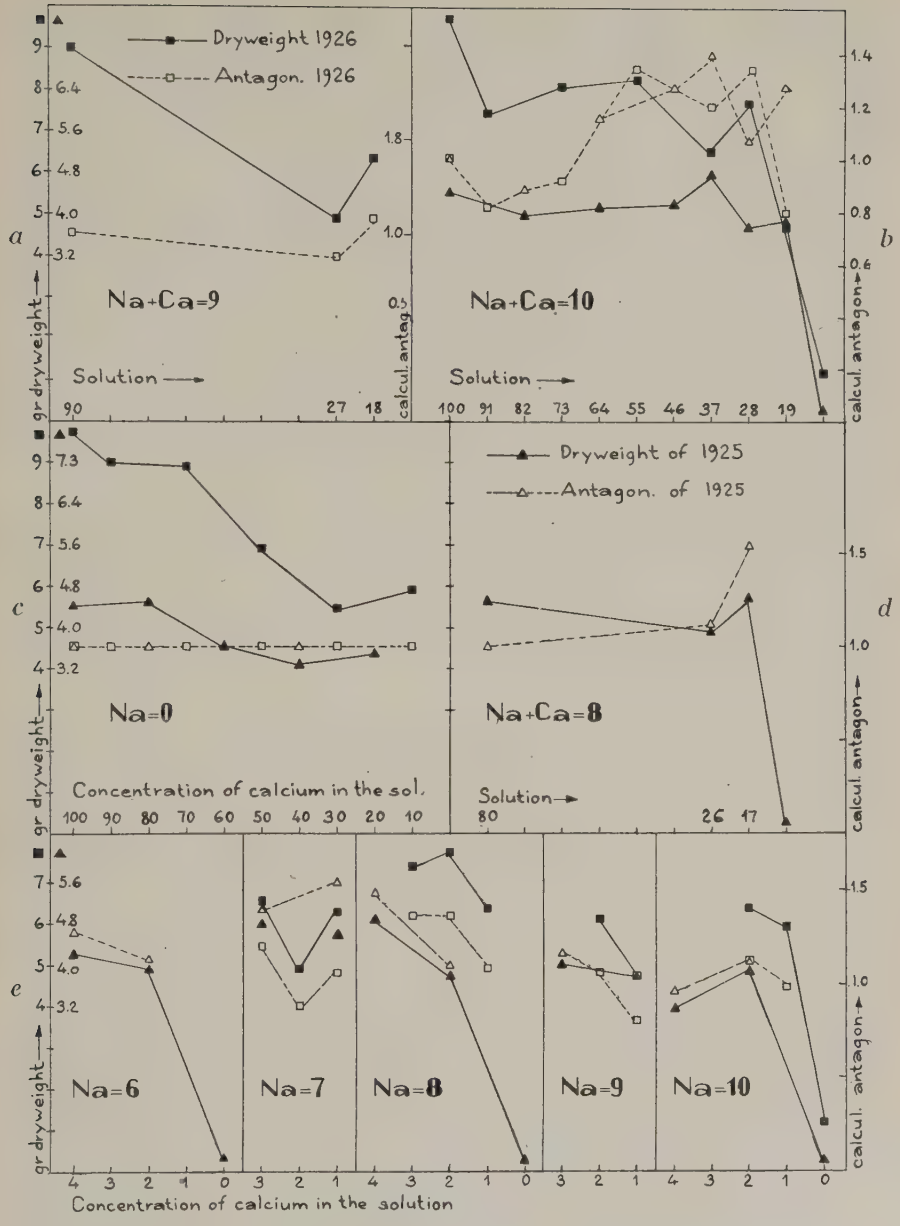

Fig. 13. Relation of dry weight and antagonism of mature tops to solutions. Series Na constant and Na + Ca constant. Experiments 1925—1926.

the right half is to be observed. The general tendency, however, is a decrease with decreasing calcium concentration, which was to be expected. This rise in the minor concentrations did not occur in the curves of any parts of the plants in 1923 (fig. 2 *f*) nor — as will be described below — in the curve of the seeds of 1926 (fig. 14 *a*, right graph). The closer agreement between curves of ripened seeds and the curves of immature plants than between the latter and the curves of mature tops will be referred to in several cases. For Na = 6, 7, 8, 9 and 10 (fig. 13 *e*) a decrease in the dry weight curves with decreasing Ca may be regarded as the general tendency of the system. The agreement between the two experiments is, however, not so good as that of the series with constant Ca. The successive alteration in form from left to right is not very smooth, either in the dry weight curves or in the antagonism curves, but this could not be expected to occur in as high a degree as in the experiment of 1924, since in the first instance the number of solutions investigated was not confined to the region in question, and the number of points is consequently too low in each graph. Further, these results are obtained from two different experiments which may not be strictly comparable in all details.

Calcium + Sodium Constant. The curves of the system Ca + Na constant (fig. 13 *a, b, d*) show a gradual alteration in their forms in both dry weight and antagonism curves, as far as comparison is possible. The curves have a maximum in points 17, 18, 28, and 37 respectively, the decrease from 80 to 26 in Na + Ca = 8 being less marked than the corresponding decrease in the other curves.

In the curves (fig. 13 *b*) Na + Ca = 10 agreement is found to exist between the general features of the results of the two experiments, but this is perhaps more marked in the case of the antagonism curves than in the case of the dry weight curves. Both antagonism curves have a minimum to the left of 64, and that of 1925 a maximum in 37 and 19; that of 1926 in 55 and 28 respectively. If we compare these curves with the antagonism curve of 1922 (fig. 4 *c*), the maximum and minimum of the curves of the mature plants agree approximately with the maximum and minimum of the curve of the immature plants in respect of the solutions where they occur. However, the magnitude of the relative differences is much greater in the curve of immature plants.

This fact will be referred to hereinafter (p. 235), where the antagonism curve of the ripened seeds will be found to be much more similar to that of the total immature plants, than happens to be the case with that of the total mature tops (compare fig. 15 *f* with fig. 4 *c*).

As a summary of this analysis of the results of the 1925 and 1926 experiments, as far as the dry weights of tops are concerned, it may be concluded that the solid figure, representing the growth in all solutions over the square in figure 1, which contains the series Ca = 1, 2, 3 and 4, has a main tendency to slope downward with decreasing Ca-concentrations. The discrepancies from this general tendency are not positively proved by the present investigation. In this slope one section crosses the xy-plane in a line approximately parallel to the x-axis in the neighbourhood of the line Na = 8, the z-coordinates of which are elevated in relation to the neighbouring sections. The maxima in the sections with constant Na + Ca must be considered as corresponding to this elevation. In spite of the restrictions, given in the above discussion, the maximum of the right half of these sections must be considered as safely established.

4. 1926 Experiment. Seeds.

Calcium Constant. The relation of the dry weight of seeds to variation in the concentration of sodium with constant calcium concentration is shown by figure 14 *b* and *c*. The change from decrease to increase with the addition of sodium, observed to occur for the entire tops from Ca = 7 to 6 in experiments of 1925 and 1926, occurs here — in accordance with the 1924 experiment — from Ca = 9 to 7. The curves of Ca = 3, 2 and 1 for the seeds agree with the curves of the tops (see above p. 229 and fig. 12), with the exception that the maximum in Na = 8 of the series Ca = 2 is more pronounced in the seed curve.

Sodium Constant. The seed curve of Na = 0 (fig. 14 *a*) decreases gradually with the decreasing calcium concentration. It agrees very well with the curves of different parts of the immature plant of 1923 (fig. 2 *f*); and even the deviation in point 90 from the usual logarithmical form, though less pronounced, is found in the seed curve. Thus, this deviation cannot be considered

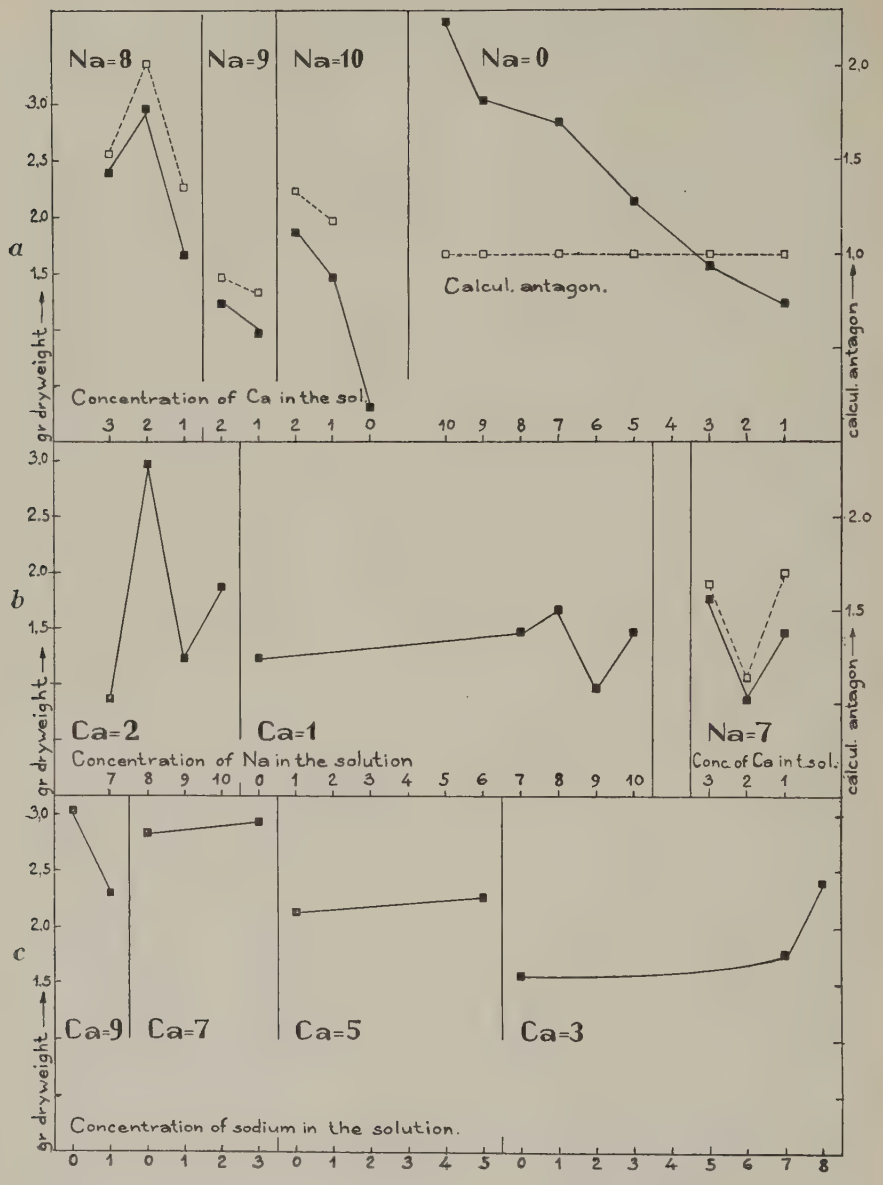

Fig. 14. Relation of dry weight and antagonism of seeds to solutions. Series Ca constant and Na constant. Experiment 1926.

as due to occasional errors, as it occurs in these two different experiments.

It must also be remembered not only that the successive harvests during the very early growth of the 1929 experiment proved that antagonistic functions were being exercised from the very beginning of the growth in these solutions without sodium, but also that the nutritive effect obtained a gradually increasing influence upon the growth with the increase of growth-time (p. 219). Furthermore, the deviation from the form, as was to be expected if only nutritive actions were exercised, is more pronounced in the curve of 1923, with 2 months' growth-time, than in the curve of the mature seeds of 1926. It must, therefore, be regarded as probable that this deviation is the last sign of these antagonistic actions, which are not fully dominated even in the resulting dry weight production during the whole growth-time. The other graphs of this series take the same course as those, recording the entire tops, except that the deviations from the general tendency to a regular decrease with decreasing calcium concentration are enhanced by the seed curves.

Calcium + Sodium Constant. This series, though only represented by three graphs plotted in fig. 15 *c*, *e*, *f*, shows a tendency to form maxima in the right part of the *x*-axis. The curves for Na + Ca =10 may be compared with the curves for 1922. The antagonism curve agrees very well with that of 1922 (fig. 4 *c*). The dry weight curve has a pronounced minimum in 91; its relative value is, however, not so low as it was in that of 1922 (fig. 2 *e*). The minimum in 37 corresponds to the minimum in 28 of 1922, which could, however, not be considered as safely established by all parallel series (compare Philipson, 1924, p. 353). The average dry weight curve of the 1929 experiment, fig. 9 *c* and p. 204, has a corresponding minimum in 46—37. The form of the curves in question must thus represent a very essential relation between the solutions and the dry matter production as it occurs in the dry weight curves from many experiments with different periods of growth.

The similarity between the seed curves and the curves in the immature total plants should once more be noted. The curves for mature tops for the same solutions in fig. 13 *b* have not so relatively great maxima.

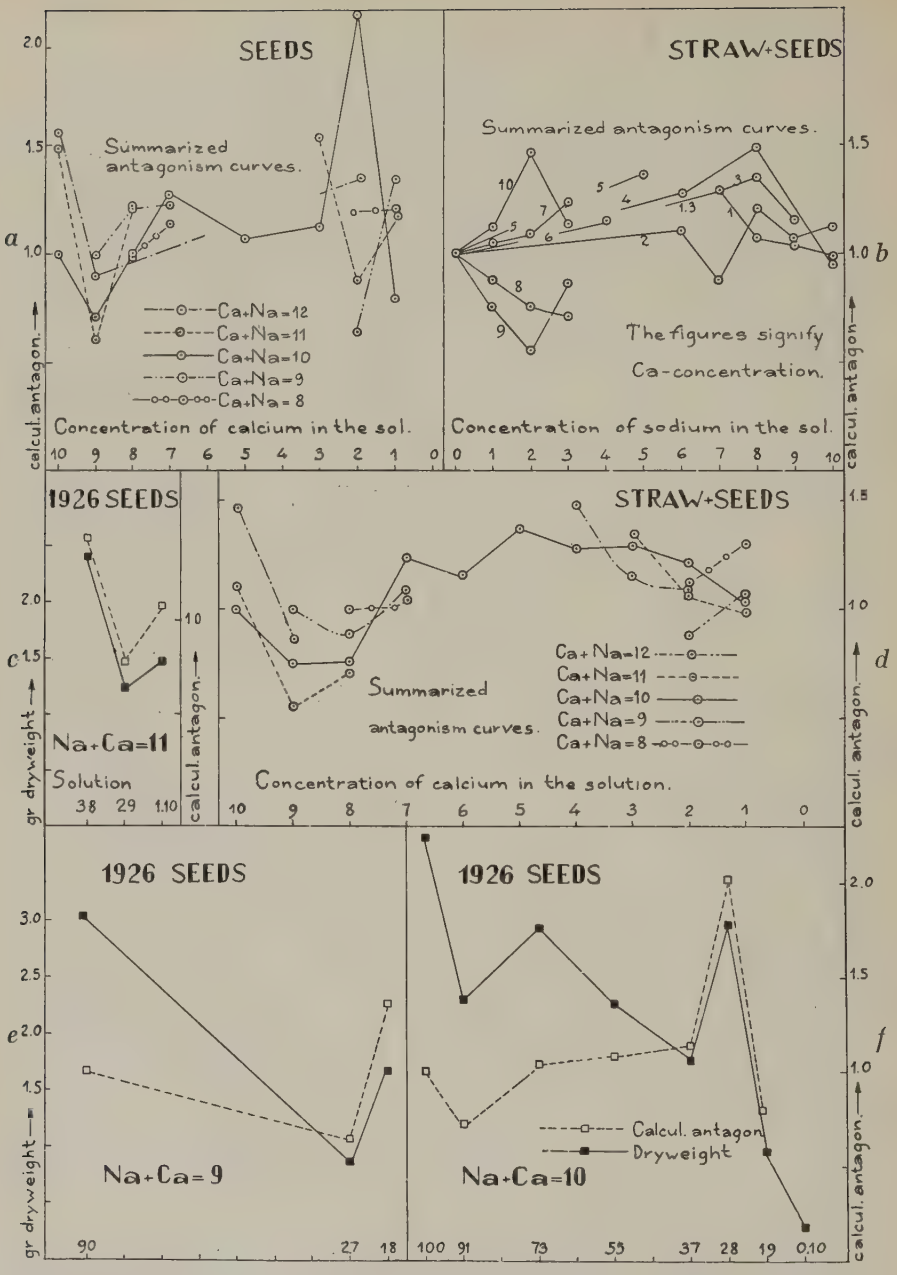

Fig. 15. Relation of dry weight and antagonism of seeds to solutions. Series Na + Ca constant. Experiment 1926. — Summarized antagonism curves.

5. Summarized Antagonism Curves.

The values of antagonism should be directly comparable in the three different experiments, inasmuch as they represent the relations between the dry weights obtained. If this be the case, curves having as ordinates the averages of two or three experiments in each point, which has been investigated several times and the values actually found in each point which was only once investigated, should show a certain regularity in their relations. Such curves have been constructed from the series with a constant sum total of sodium and calcium in *d* and *a* of fig. 15 representing the dry weight of tops and seeds respectively. Fig. 15 *b* represents the top growth for the series calcium constant.

Fig. 15 *a* is, perhaps, the most easy of interpretation. The complete curve for Ca + Na = 10 has one minimum in 91 and one maximum in 28. The drop from 100 to 91 is borne out by the drops in the curves of Na + Ca = 12 and Ca + Na = 11. The rise from 91 to 82 is confirmed by the rises of the curves Ca + Na = 11 and Ca + Na = 9; and the rise from 82 to 73 by the rise in the curve Na + Ca = 8, and the unappreciable rise of the curve Ca + Na = 9. The maximum of 28 seems to lie between one maximum in Ca = 3 for Ca + Na = 11 and one maximum in Ca = 1 for Ca + Na = 9.

Finally, it should be noted that the form of the whole curve of Ca + Na = 10 is very smooth, and has a minimum between 55 and 37. The different antagonism curves obtained by all the experiments in this paper did not actually show a minimum in these solutions, with the exception of the curve of 1929 (fig. 9 *a*). The antagonism curve of 1922 was, however, not determined in these points, it was nearly identical with the calcium utilization curve (p. 187), for which a minimum in these points had to be assumed if compared with the utilization curve of 1929 (p. 215). The minimum in these points of the summarized curve of 1924 and 1926, seems thus to be at least made probable by this discussion. — The summarized curve in question has thus many relations which point to the truth of the whole discussion.

A quite analogous discussion of fig. 15 *d* should show the regularity with which the curves of the graph support each other.

The right top graph, finally, shows that the curves of Ca = 10, 6, 7 and 5 are all above the line representing unity, the curves

of Ca = 9 and 8 below this line. Thus, the course of Ca = 9 may be said to be supported by the course Ca = 8; the curves of Ca = 5, 6 and 7 confirm each other. The curves of Ca = 2, 3 and 4 have a maximum in Na = 8, the curve of Ca = 1 a maximum in Ca = 7. With the exception only of the point Na = 7 in the curve Ca = 2, the curves are as smooth as they can be, since they have been constructed only through a few points each.

The test thus afforded by the summarized curves may be considered as proving the thesis for which it was applied, viz. the comparability of the experiments as far as the antagonism values are concerned (compare p. 164).

VIII. GREY-SPOT DISEASE.

In the paper by the author (1924, p. 349—353) the occurrence of the grey-spot disease in the 1922 and 1923 experiments was dealt with. The occurrence of the disease in the 1924 and 1926 experiments was recorded before maturity, and the results are given in table XVII, the ratio between sick and total plants being given for each jar. The solutions, in which no disease occurred have been omitted from the table. In the 1925 experiment no trace of the disease could be found. The occurrence in the 1929 experiment has been given separately for the fifth and sixth harvest with a cross in table XVIII. The brackets in both tables designate a weak attack of the disease.

In the first instance it must be concluded that the occurrence of the disease does not merely depend on factors controlled in the experiments, as in the 1925 experiment no disease occurred and in the 1926 experiment the attacks were much more disseminated over the solutions, than in the 1924 experiment. As the P_H of the solutions was about 5.0 in all years, too high an alkalinity cannot have been involved in the causation of the disease.

As to the regularity of distribution, it must first of all be observed that the plants grown in solution 91 have always been strongly attacked by the disease, as was also found in the 1922 experiment (Philipson, 1924, p. 349).

In the 1924 experiment the disease occurred only in solutions 91 and 92; and was also slightly indicated in 90. The plants grown in all other solutions were entirely free from the disease

Table XVII. **Occurrence of Grey-Spot Disease.**

Solution	1924	1926	Explanation
100	0, 0, 0, 0, 0	2/6, 2/6, 0	The figures represent the number of sick plants to total number of plants in the jar. The brackets signify a weak attack of the disease. Jars with no sick plants have been denominated with 0. The solutions, in which no disease at all occurred have been omitted from this table.
90	0, 2/6, 0, 0, 0	3/6, 0, 0, 0, 0	
91	6/6, 4/4, 2/6, 3/6, 0[1]	2/6, 3/5, 2/6, 3/6, 3/6	
92	6/6, 2/5[1], 5/5, 2/5, 0		
70	0, 0, 0, 0, 0	2/6, 5/6, 0	
73	0, 0, 0, 0, 0	[4/6], [2/6], [4/6], 0, 0	
50		1/6, 0, 0, 0, 0	
30		2/6, [1/6], 0, 0, 0	
37		[1/6], 0, 0, 0, 0	
38		2/6, [1/6], 0, 0,	
27		[2/6], 0, 0, 0	
28		1/6, 0, 0, 0	
29		2/6, [1/6], 0, 0, 0	
2.10		[1/6], 0, 0, 0, 0	

[1] The roots in these jars grew above the lid and therefore possibly obtained sodium from the dust in the air.

as far as the 1924 experiment is concerned. Thus the disease was distinctly correlated in this year to the minimum of dry weights in 91.

In the 1926 experiment the plants grown in 91 were strongly attacked by the disease, which also occurred in one of the jars with solution 90 and in two of the jars with solution 100. The corresponding area of figure 1 is approximately the same as that representing solutions favouring the disease in 1924. But also the plants grown in 70 and 73 were attacked by the disease, though the attack in 73 was weak. Only one plant in 50 was sick; and in 55 all plants were healthy. In 38 three plants were attacked; a slight indication of sickness was discovered on one plant in 37; and in 30 three plants were sick. An equally small number of sick plants was also recorded for 27, 28, 29 and 2.10. In solutions 10, 17, 18, 19 and 1.10 all plants were healthy.

The experiment thus showed that two sets of solutions are favourable to the occurrence of the disease. The first was correlated to the minimum of dry weights in 91, the plants grown in

these solutions being more frequently attacked than those grown in the other set of solutions. This slight attack was in a small measure correlated to the minimum in 37 of fig. 15 *f*. The solutions 55 and 10, 17, 18, 19 and 1.10, which produce entirely healthy plants, are, however, not so clearly correlated to the optimal solutions. These latter, viz. 100, 73 and 28, are symbolized by points in figure 1 lying on the edges of the areas in which the disease occurred.

In the table for 1929 experiment the signs refer only to the whole crop. As has been stated before, the plants have not been separately weighed and analogously with this the disease has also been recorded for the total crop from each jar. The disease could be discerned also in a few points on the 3rd and 4th crop. As this record does not interfere with the conclusions which may be drawn from the records for the 5th and 6th harvest, it has been omitted from the table. The disease on these young plants

Table. XVIII. **Occurrence of Grey-Spot Disease. Experiment of 1929.**

Solution	Harvests		Explanation
	5th	6th	
100	+	(+)	+ the crop attacked by the disease.
91	+	+	
90	+	(+)	(+) the crop slightly attacked by the disease.
82	+	+	
73	+	+	— the crop unaffected by the disease.
70	+	(+)	
64	—	—	
55	—	+	
50	(+)	(+)	
46	(+)	(+)	
40	(+)	(+)	
37	—	(+)	
28	—	(+)	
20	(+)	(+)	
19	—	—	
10	+	(+)	

was only noted on the spots on the leaves. The sick plants appeared as turgescent as the healthy ones. Decreased turgescence was noted for the 1922 experiment on the sick plants that were 2 months old (PHILIPSON l. c.). This decrease in the turgescence may thus either mean a secondary effect of the disease, or it may be more directly connected with the influence of the solution. The signs between brackets in the table signify crops on whose leaves only a few brown-edged spots could be distinguished. The tables XVII and XVIII are thus only comparable as to the distribution of the disease, but not in respect of the magnitude of the attacks.

A comparison of the distribution of the disease in the 1929 and 1926 experiments shows quite a satisfactory agreement. A difference which may be noted is the occurrence in one crop in 55 of the 1929 experiment, while the 1926 experiment had only healthy plants in this solution; in the 1929 experiment both crops in 64 were healthy. Also solution 10 of the 1929 experiment produced sick plants, whilst the same solution of the 1926 experiment was unfavourable to the occurrence of the disease. It must be mentioned, however, that the plants grown in this solution in 1926 were quite starved in calcium. As has been pointed out before (part VI, p. 219) the effect of starvation in calcium is not very marked in the first weeks of the growth-season. The solutions 10 of respectively the 1929 and 1926 experiment are thus not strictly comparable, the intensified starvation of calcium may exercise influences on the growth which may be involved in the causation on the grey-spot disease. On the whole, it must be concluded that the records of the distribution of the disease from the two experiments confirm each other.

It must thus be considered as proved that the balance between calcium and sodium in the solution is essentially correlated to the occurrence of grey-spot disease (cf. PHILIPSON l. c. and ARRHENIUS, 1923 and 1924 *a*). In figure 1 two areas can be designated as symbolizing solutions which make the plants susceptible to the disease. The solutions symbolized by one of these areas produced greater susceptibility than those symbolized by the other. Within these areas points exist symbolizing solutions which produced inferior growth to that obtained in solutions represented by points on the edges of the areas concerned. The solutions which essentially

decrease the susceptibility of the plants are not so closely related to the dry weight curves. The disease must also be due to one or more uncontrolled factors (see above and ARRHENIUS, 1924 *a*, p. 204—205). — Cf. also ERIKSSON (1930, p. 478) who connects the disease with an infection by *Scolecotrichum graminis* Fuck. *f. avenae* Erikss. No black dots in the grey-spots on the leaves, such as he examined and found to be the mycelium of the fungus, could be observed macroscopically in the material of the present investigation.

IX. EXPERIMENT 1925 B. SUGAR-BEETS.

In order to get a comparison with another plant as to the influence upon its growth of varying amounts of sodium and calcium in the nutrient solution, a brief account of an experiment with sugar-beets in sand culture shall be recorded here. The author was animated by ARRHENIUS to study this influence on the growth of sugar-beets, especially in respect of its relation to phyllonecrosis, to which he had stated an analogous correlation of a too high calcium percentage in relation to other ions in the nutrient solutions, as has been described before for the grey-spot disease in oats (1924 *b*, p. 264—265).

The growth medium for this experiment was Hohenbocka-sand, which is the purest obtainable. This sand, however, proved to be too fine, as it presented too great an obstacle to the permeation of the free air to the roots, when moistened with the nutrient solution. The appearance of the roots of the beets was, therefore, not normal, inasmuch as branching occurred in nearly all cases. The root-growth seemed to have been limited by too low a supply of oxygen.

As, however, a certain tendency of the numerical values of the harvest, as well as the records of phyllonecrosis, points to similar actions as were found operating in the oats-experiments, the experiment will here be dealt with, though the restriction as to this oxygen limitation must be remembered in this connection.

The cultures were grown in wooden barrels cut in two, the sand being watered daily with nutrient solution until it leaked out of the bottom of the vessels, as a compensation for the continuous flow of the water cultures. The solutions were the same

as that used for the previous work, except that the P_H of the solution was adjusted with KOH to be equal to 7.5. This is in fact the optimal point, as has been found by ARRHENIUS (1925, p. 94). Six beet seedlings were planted in each vessel; after a month three of them were pulled up to avoid crowding in the vessels.

On harvesting the beets were divided into roots and tops. The fresh weight and dry weight of the tops were estimated as usual, the top of each plant separately, and the values are rendered in table XIX. The root — after washing — of each plant, was divided into two parts, each one being weighed separately in the same state in which it was harvested. One of these parts was dried, and its dry weight determined. The other was used for analysis as to its sugar percentage, which was carried out by the laboratory staff of the Svenska Sockerfabriksaktiebolaget. The figures for fresh weight, sugar percentage, and dry weight of the entire roots, given in table XIX, have been calculated in the following way. The fresh weight was obtained by the addition of the fresh weight of the parts; the sugar percentage was corrected in taking into consideration the difference in fresh weight of the analysed part at the harvest and at the analysis (a difference which was, of course, due to evaporation during transport). The dry weight of the other part divided with the fresh weight of the part gave the percentage of dry matter, and this, multiplied with the fresh weight of the entire root, finally represents the dry weight of the entire root. All figures of a in the table are averages of the nine plants of each series, with the exception of the sugar percentage of solution 100, which is calculated for 8 plants, as one plant had a greatly deviating value, accompanied by a reddish colour of its root. The table (b) also renders the figures for the attacks of phyllonecrosis in the terms of the ratio between sick and total number of plants of each vessel, weak attacks being stated within brackets.

The results of the first part of the table have been plotted in the curves of figure 16 over the solutions on the abscissa axis. All curves tend to a minimum in 82, and a maximum between 46 and 19. The differences are not very great, however, though the smoothness of the curves seems to justify the following conclusion: Under the conditions of this experiment the growth of sugar-beets holds essentially the same relation to the ratio between sodium and calcium

Table XIX. **Sand Cultures with Sugar-Beet 1925.**

a. Averaged values of

Solution	Roots			Tops		Total	
	Sugar-percentage	Fresh weight gr.	Dry weight gr.	Fresh weight gr.	Dry weight gr.	Fresh weight gr.	Dry weight gr.
100	16.52 ± 0.15 [1]	392 ± 31	96 ± 7	309 ± 22	46 ± 4	701 ± 44	142 ± 10
82	17.45 ± 0.38	270 ± 33	70 ± 8	179 ± 21	30 ± 4	450 ± 53	101 ± 11
64	16.74 ± 0.47	349 ± 31	87 ± 8	274 ± 32	45 ± 4	623 ± 60	132 ± 12
46	17.09 ± 0.30	367 ± 42	93 ± 8	287 ± 42	49 ± 6	655 ± 78	142 ± 13
28	16.77 ± 0.24	352 ± 25	89 ± 6	339 ± 32	51 ± 4	691 ± 37	140 ± 9
19	16.15 ± 0.25	371 ± 32	91 ± 8	303 ± 39	46 ± 5	674 ± 64	137 ± 12
010	16.53 ± 0.32	318 ± 32	84 ± 7	229 ± 14	38 ± 3	547 ± 48	122 ± 9

[1] Determined from only 8 plants.

b. Occurrence of phyllonecrosis.

100	$^2/_3 + (^1/_3)$	$^2/_3$	$^2/_3$
82	0	0	0
64	0	0	0
46	$^1/_3$	$^1/_3$	$^1/_3$
28	$^1/_3$	$^1/_3$	$^1/_3$
19	0	$^1/_3$	$^1/_3$
010	$^1/_3$	$^2/_3$	0

along the line of Na + Ca = 10 of figure 1, as does the growth of oats, in so far as the occurrence of a maximum to the right of 46, and a minimum to the left of 64, is concerned. This is more pronounced for the fresh weight of tops than in the other relations. As, however, the roots especially were limited in their growth by a diminished oxygen-supply, not too much stress will be laid on the last-mentioned conclusion.

The phyllonecrosis of the sugar-beet is according to GÄUMANN (1925, p. 96, also complete discussion of the literature) to be considered as caused by physiologically induced susceptibility to the infection by *Phoma betae* (Rostr.) Oud. The disease is in the first instance related to the acidity of the soil, in the second to

the balance between calcium and other ions, and in the third — to a certain degree — to the physical properties of the soil (l. c., p. 97). The two first-mentioned relations have been propounded by ARRHENIUS (1923). Though the material recorded in the table is not sufficiently large to permit of any decisive conclusions, a strong attack is suggested in solution 100, containing the largest

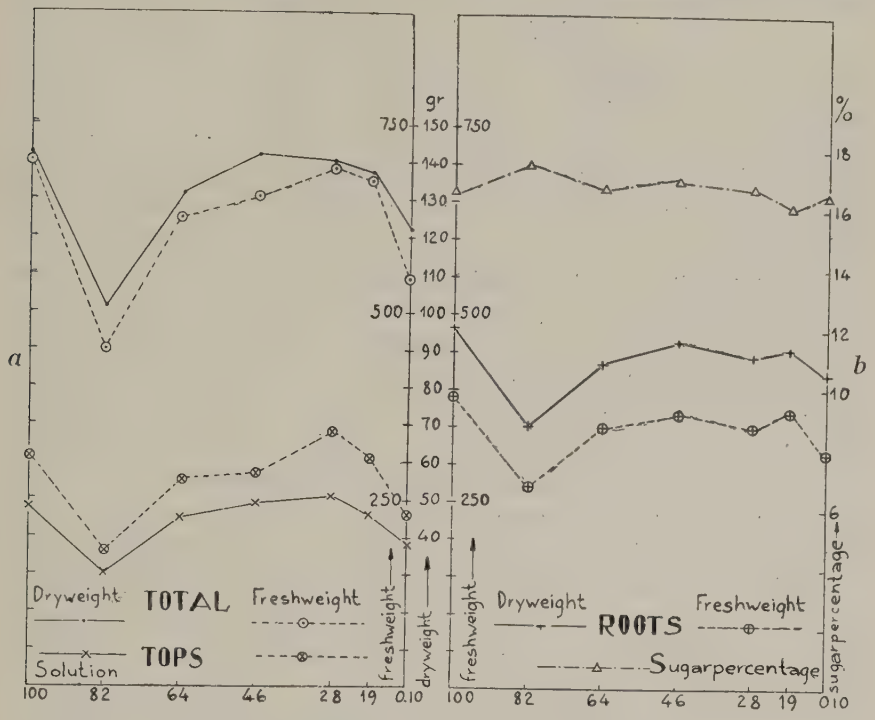

Fig. 16. Relation of the growth and sugar percentage of sugar-beets to solutions. Experiment 1925 B.

percentage of calcium in proportion to other ions. The cultures, watered with solutions 82 and 64, were quite healthy; the others nearly all included one sick plant. The disease seems thus peculiarly enough to be restricted to the optimal points of the growth-curves, the grey-spot disease of the experiments with oats was instead to a certain degree correlated to minima of the growth curve (p. 241). The influence of the alkalinity of the solution could not have been a dominant factor in the occurrence of the disease, as the distribution of the sick plants was confined to certain of the solutions, though all had the same P_H.

The sugar percentage varies irregularly with the abscissæ of fig. 16 *b*. The differences are very small in comparison with the mean errors. Between these limits the sugar percentage of the roots is independant of the variation of the sodium and calcium concentration.

X. GENERAL CONSIDERATIONS.

1. Definition of the Term Antagonism.

In the paper of 1924 the author defined the term antagonism as the "effect of the ratio between certain ions upon plant growth, distinguished from the pure nutritive effect of the corresponding salts", without involving any preconceived notion of the causation of the phenomenon in the definition of the term (p. 343, lines with spaced letters). The chief conclusion of the publication concerned contains the statement that the experimental results can only be understood provided that the antagonism in that sense is exercised simultaneously with the nutritive effects of the salts in the dilute solutions investigated (l. c. p. 357). Without giving the credit of priority to the author, HOAGLAND and DAVIS (1929, p. 617—618) put forward a suggestion of the same idea, concerning the influence of one ion upon the accumulation of another in *Valonia* and *Nitella* cells, determined by analyses. They state: "The question may therefore be raised once more whether in case of solutions of nutrient type the reciprocal ion effects should be placed in the category of antagonism."

The question of how to define antagonism must not be considered as only a formal one. OSTERHOUT's definition (see e. g. 1922, p. 124) implies the necessity of considering the pure solutions as being toxic to plant growth. This may be sound as far as concentrated solutions are concerned. In dilute solutions, however, reciprocal actions between ions have also been demonstrated in the present paper as well as in the author's paper of 1924 (cf. also TOTTINGHAM 1914, and HOAGLAND, 1929), against OSTERHOUT (1907 *b*, p. 318, and 1914 *c*). As to whether this influence of the ratio between ions on the growth and absorption is to be called antagonism or not, cannot be answered until the mechanism of this influence of the balance between ions in dilute and concentrated solutions has been completely elucidated.

Until this has been done, we may use the same term for all concentrations, provided we always remember that this term refers to many processes which have not been proved to be causally related. But even in the more restricted sense of the term this may very well be true. As a matter of fact it has in this sense been used for all kinds of plants and animals; for the actual intake of ions by unicellular organisms and the growth of agricultural plants for a considerable time in soil and solution cultures. It may be true that all terms used for designating commonly occurring phenomena, the causation of which is not thoroughly elucidated, are subject to the same restriction. When using the term also for dilute solutions, the definition by OSTERHOUT (see above) leads one to think of small concentrations of mineral nutrients as being toxic to the organisms. As has been pointed out by BONDORFF (1924, p. 315—316) it is a very complicated problem whether this conception is true or not. In order to remove any preconceived view of the solution of this problem, the new definition of antagonism has been selected for designating the phenomenon here referred to. Moreover, the extensive use of the term in colloid chemistry seems to the author to imply the necessity of excluding the word toxicity from its definition.

In a recent paper RUBINSTEIN (1928) puts forward a suggestion as to a more stringent definition of antagonism. He connects this term to the equalizing of the effect of two ions, when the concentrations of the ions have a symbatic relation to each other. The mixtures of calcium and sodium used in the investigation described in this paper do not permit of a comparison along such lines (see fig. 1). That this definition of the term may prove to be very sound, is suggested especially by RUBINSTEIN's treatment of his polar antagonism, i. e. an antagonism exercised by ions which pure have a similar action upon the process used as criterion. The discussion of the apolar antagonism, i. e. the equalizing of the effect of two differently acting ions, seems to the author to be a trifle strained.

2. The Measurement of Antagonism.

The quantitative criterion of antagonism has always been derived in the present paper according to the suggestion previously put forward by the author (1924, p. 362—367). One of the most

essential premises from which this method of derivation was deduced, was the simultaneous exercise of nutritive antagonistic effects of the salts. This premise was proved in the paper in question (p. 357, 354 and the present paper, p. 220). Three formulæ were used for the calculation implying three specialized assumptions of the cooperation of two factors on the growth. From the similarity of the three resulting curves the author concluded that the features common to these curves show the antagonistic effect between calcium and sodium. Behind the method of calculating a hypothesis concerning the limited influence of a nutritive effect of sodium is concealed, as well as of the antagonisms between each of the varied ions in relation to other ions of the solution. The last-mentioned point has been subjected to criticism by Mevius (1924). No other reasons than those given in the paper referred to will be offered for the probability of the hypothesis (p. 345 and 355—357, cf. as to the influence of chlorine Tottingham, 1917, and Trelease, 1917). If the hypothesis is not true, the antagonism curves are due to simultaneously exercised antagonisms between all ions of the solution and the nutritive effect of sodium. The fact that the nutritive effect of calcium is eliminated by their derivation is thus not contradicted by this possibility.

Osterhout's quantitative criterion on antagonism (1914 *a* and *b*) is derived in a very similar way to that described in the author's paper of 1924 on the assumption 1 (p. 364). He uses the percentage of the increment in growth produced by the mixtures of two salts related to the additive effect of the salts. The additive effect of the salt for a certain concentration of calcium, as far as sodium and calcium are concerned, may be said to be equal to the ordinate of the curve $Na = 0$, provided the hypothesis given above can stand the test. In assumption 1 the antagonistic effect was expressed as the proportion between the ordinate for the mixture and the ordinate of the corresponding point for $Na = 0$.

In the present paper this last-mentioned formula has always been used when calculating the antagonism curves plotted in the figures. In many cases, however, a comparison with the curves calculated on the other assumptions has been made, and a material similarity between the resulting curves derived from the three formulæ could always be stated. In part IV (p. 189) the close agreement between the antagonism curves and the calcium utilization curve was found to support the method of expressing the difference between the solutions.

3. Permeability and its Relation to Antagonism.

The conception of the word permeability of the plant to a certain substance as a stringently defined term is only possible if an analysis of the diffusion through the cell membranes were possible. Such an analysis, as far as the exudation of water by plant-tissues is concerned, is made by Stiles in his excellent monograph on permeability (1922 *a*, p. 238). He assumes the driving force of the absorption process to be the difference between the osmotic pressure of the external medium and the osmotic pressure of the cell, diminished by its turgor pressure. The rate of exudation is then expressed by a product of this driving force and the area of the cell surface concerned, multiplied by a magnitude which is considered as the permeability of the cell to water, which is thus taken to mean the quantity of water passing the unit area in unit time under unit difference of pressure. — This definition would have been more up to date if the activity of water had been taken into consideration.

This may be compared with pages 233—234 of the same paper where the intake or excretion of water is said to depend both on variation in the osmotic relations caused by reactions in the cell, by the entrance or exosmosis of dissolved substances, and by the changes in the swelling capacity of the cell, and on direct alterations in permeability thus defined. This, compared with the statement that the change of permeability to dissolved substances involves much more complicated problems (1923 *d*, p. 216), facilitates the conception of the impossibility of a stringent definition of the permeability of the cell to dissolved substances (cf. also 1921, p. 45—46). Changes in the rate of absorption therefore do not necessarily imply a change in permeability (cf. 1923 *a*, p. 1—2).

The nature of the equilibria involved has also to be taken into consideration. As has been found by Hoagland and Davis in a recent paper (1929), and Collander (1930), certain ions accumulate in the cell, the concentration reached within the cell being much higher than that of the growth medium (cf. also Hoagland, Davis and Martin, 1923, p. 645, and Stiles, 1923 *b*, p. 77—81, and 1927, and Brooks, 1929). Stiles (1927, p. 598, cf. Pantanelli, 1929) puts forward the suggestion of adsorption processes as an explanation of the absorption against the diffusion gradient, whilst Hoagland and

Davis (l. c., p. 621—622) are of opinion that the data relating to conductivity, as well as the osmotic relations of the cell, are not in agreement with an adsorption hypothesis. They propound an explanation of the accumulation of ions founded on the energy relations of the cells (cf. Höber and Höber, p. 272). This opinion, however, does not appear to be proved by the discussion put forward by the authors quoted, the modern theories of the physical-chemical properties of such complicated systems as the living cell, are not thoroughly elucidated so as to permit of a stringent deduction of the thesis concerned. From the above discussion it must be concluded that at the present stage of our knowledge we cannot determine whether a change in absorption is actually due to changes in permeability or to the alteration of the driving power, which may be the diffusion gradient — expressed in terms of activities — or not (cf. Collander, 1930, p. 15).

The results of the present investigation point generally to a change in the absorption of substances with the variation of sodium and calcium present in the nutrient solution, as was stated in part IV and VI (p. 151, 187 and 210, 215). Whether this change is due to alterations in the permeability or not, cannot be safely stated. But as the investigations by Hansteen Cranner (1910, 1914 and 1922) have proved that the salt-balance exercised pronounced actions upon the cell membranes of the roots, it is extremely probable that these alterations in the absorption of ions must be at least partly due to changes in the permeability of these membranes.

The correlation between antagonism and permeability has many a time been stated in literature (see Rubinstein, 1928, p. 258, Lucké and Mc Cutcheon, 1929, Mevius, 1927, Hansteen Cranner, 1910, 1914 and 1922, and Stiles, 1923 *c*, p. 134—149). But no safe indication of the change in permeability as being the cause of antagonism on the process used as criterion, has so far been offered. Such indications must be founded on clear evidence of the mechanism of permeability, which is not yet available.

Multitudes of theories of the mechanism involved in permeability have been advanced (Stiles, 1923 *d*, p. 217—224 and 1923 *e*, p. 240—245). Brooks recently made a valuable suggestion on this subject (1929, cf. Collander, 1930, p. 14). Recent investigations on artificial membranes seem to facilitate the understanding of the laws governing this mechanism (Collander, 1925, Höber and

Hoffman, 1928, Mc Dougal and Morávek, 1927). Lundegårdh and Morávek (1924), Kahho (1926), Niklewski and collaborators (1928), Lemańczyk (1926), Höber and Höber (1928), and Gurewitsch (1929) attribute the alterations in permeability to the influence of the penetrating substances on the cell colloids. Bärlund (1929) has published a series of investigations on plasmolysis as a measure of permeability, from which he concludes the nature of the processes involved in the salt intake. The theory advanced by Hansteen Cranner (1922) has not been thoroughly dealt with in the literature reviewed, though the conclusions of many of these papers might well be understood in terms of this theory (see Gurewitsch, 1929, p. 698—701). The whole impression conveyed by the vast literature on this subject is rather confusing. The concluding remarks by Stiles (1923 *e*, p. 245—246) may be said to be true also now. They point to the inadequacy of a multitude of speculations which have been propounded on this matter (cf. also Wieringia, 1930, and Collander, 1930, p. 15).

In the present paper it has also been stated that the calcium absorption curves over time showed a more or less pronounced tendency to inflection. This was compared with Burd's ecological curves (p. 200). Niklewski and his collaborators also give us a discussion on experiments in which exosmosis of Ca and Mg occurred (p. 102—103). They explain the absorption of different amounts of the ions of one salt to be balanced by exosmosis of ions from the cell (p. 108, cf. Lemańczyk, 1926, p. 1150—1151). Niklewski and his collaborators also obtain an inflecting time-curve for the absorption of the potassium and chlorine, which is explained by the assumption of a saturation of the cells concerned (p. 109).

It may be noted that the conception conveyed by the aforesaid literature to the effect that the specific influence of calcium is a decrease in the permeability of all membranes. But Denny has found that calcium chloride increased the permeability of seed-coats to water (1917, p. 473—475, cf. also Calábek and Morávek, 1930). In this connection it may be mentioned that True (1921) considers the function of calcium to be to make the other ions available for the plant. The function of calcium, especially on the growth of root-hairs, has been extensively studied by Farr (e. g. 1928).

4. Internal Processes related to Antagonism.

In the present paper it has been stated (IV, p. 186) that internal actions are correlated to antagonism also. The results afforded by Waynick might be interpreted in this direction, though cell permeability may also be implied (1928, p. 166).

Much of the evidence brought forward in the papers quoted, when discussing theories of permeability, on the similarity of actions of salts on biocolloids to those on the plant cells, might also be used for explaining the internal actions of salts. Evidence which may also be used for this purpose, has been contributed by Ruhland (1908), Höber (1920), Kahho (1921), Hattori (1921), Bethe (1922), Raber (1923), and Calábek and Morávek (1930). All these investigations deal with the influence of salts on biocolloids, in vitro or in vivo. It must be understood that these actions must be exercised within the cells as well as on the cell surface.

In this connection it might be mentioned that Sorokin and Sommer recently (1929) published an account of cytological investigations into cells and tissues of the root-tips of *Pisum* grown in complete solutions and calcium free solutions with and without magnesium. The effect of the absence of calcium appears to be confined to the mitosis, which was altered successively to almost typical amitosis — or rather the occurrence of restitution nuclei in the meristematic region (l. c. 34).[1] The observations made by Hansteen Cranner on the disintegration of cell walls are said to depend on the presence of bacteria (p. 32). This statement appears to require further study. The actions actually found are considered as being due to either a direct effect on mitosis or a chemical or physical-chemical influence upon protoplasm as a whole.

Antagonism related to respiration has been studied by Lyon (1921) on *Elodea*. He obtains a double optimum curve for the respiration plotted against the ratio between Ca and Na according to the method used in the present paper.

5. Concluding Remarks.

In the present paper it has been stated that the antagonism between calcium and sodium defined and measured as described

[1] This statement was discussed with Professor O. Rosenberg, who was kind enough to give it his attention.

on the previous pages, was closely related to the absorption and utilization of calcium (p. 181, 216—217) and to the internal processes, which connect the dry matter production with the amount of calcium actually absorbed (p. 186, 218). Furthermore, it was found that the antagonism did not influence the internal processes, which correlate the dry matter production and nitrogen assimilation (p. 184). And the antagonistic effect was also analyzed into two effects, one exercising a pronounced influence already from the beginning of the growth, the other being prominent in the latter period of the growth-cycle (p. 216—217).

These relations have been compared with the results arrived at by various other investigations quoted here above. The whole discussion may indicate a common sequence of causations, which should explain all the processes concerned. Such a suggestion has been propounded by OSTERHOUT (1917 *a*) in the following words: "What has been said may suffice to indicate how stimulation, vitality, injury, recovery together with permeability and antagonism may be brought under a common point of view, and perhaps traced to similar fundamental causes." That these fundamental causes may be explained in the terms of OSTERHOUT's rather speculative theory, is, however, not true (cf. STILES, 1923 *c*, p. 147—149). It is also probable that the opinion put forward by RUBINSTEIN (1928, p. 311—312) to the effect that antagonism is to be considered as a heterogenous phenomenon, which may be analyzed into widely different processes, is more adequate. The present author does not yet wish to go any further into the theoretical speculations, as his aim has been more in accordance with the following lines by STILES (1923 *e*, p. 247): "While propounding of theories will continue to satisfy the minds of some, yet it cannot be too strongly emphasized that what are wanted to lay the foundations of a proper understanding of the phenomena of permeability in plants are facts, and particularly quantitative data."

SUMMARY.

1. The problems of the investigation were formulated so as to contain the relation of dry matter production and absorption to varying concentrations of calcium and sodium in the nutrient

solutions during different stages of plant growth. It has been emphasized that the mechanism of permeability and other related processes would only be considered in so far as a comparison with the investigations previously published was concerned.

2. The method for the investigations were described, involving continuously renewed solution cultures with oats. The accuracy of all estimations was considered with reference to direct tests. The method of stating the results has been given (see fig. 1, p. 160), and discussed as to its principles (p. 159—163).

3. The results have been plotted in graphs, which demonstrate series of sections of the solid figure, giving the complete graphic representation of growth as a function of calcium and sodium concentrations, independently varied, in the solution. The sections chiefly studied are the diagonal section, in which the sum total of these concentrations is constantly equal to the highest concentration used of either ion — series with sodium — and the marginal section, in which sodium was constantly absent — series without sodium.

4. The relation of dry weights obtained to the nutrient solutions has been given for a growth period of one to three weeks (p. 204—210), and two months (fig. 2 *e* and *f*); and for mature plants and seeds (p. 221—235). The investigations fully demonstrate the diagonal section — chiefly studied — of the solid figure representing growth. The dry weight curves of both series — with and without sodium — alter their aspects as time passes. This is explained by the increasing influence of the nutritive effect of calcium in both series, and with a gradual increase in the influence exercised by the antagonistic effect in the series with sodium (p. 214). — The dry weight time-curves for the first three weeks have been found to follow Blackman's formula (p. 200).

5. The nitrogen content curves have been established to follow as a rule the course of the dry weight curves for two months of growth. The same statement has been found true in respect of the ash content (p. 181).

6. The calcium content curves show alterations, as time passes, in the same direction, but much more rapid than the dry weight curves do (p. 210—211). The calcium absorption after two months of growth was approximately proportional to the concentration of calcium in the nutrient solution in the absence of sodium (p. 179). — The increase of the calcium time-curves during

the first week of growth was more rapid than the corresponding increase in dry weight. In some solutions these curves appeared to show an inflection during the first three weeks of growth. (p. 200—201).

7. The calcium utilization curves — i. e. the amount absorbed divided by that given in 100 cc. of the solution — were for purposes of comparison multiplied by factors expressing the ratio of the amount of solution at disposal for each plant in the experiments concerned. Thus compared, the curves for all periods of growth investigated agreed in all but one of the solutions investigated in the series with sodium (p. 215). In the series without sodium the curves concerned showed a similar, but not so rapid, alteration as that which was found for the calcium content curves during the course of the growth-period (p. 217).

8. The antagonistic effect, calculated in the manner described in the author's paper published in 1924, resulted in similar curves for dry matter and absorption in the different growth-periods. In the early period, however, the extremes were not so pronounced as those found for two months of growth, which could be explained in terms of the change in the form of the curves, summarized in 4 and 6, here before (p. 213).

9. The antagonism curves were, in so far as the period of two months was concerned, strikingly similar to the calcium utilization curve for the series with sodium (p. 187—189).

10. The antagonism curve for dry matter of this period agreed with the equivalent well-supported section of the solid figure, giving the complete representation of antagonism, in so far as ripened seeds were concerned (p. 235).

11. By comparing the different statements summarized in 7—9, the antagonistic effect could be analysed in two processes, one being more pronounced than the other in the early utilization curve, in a certain correlation to their influence upon the early antagonism curve (p. 216—217).

12. From all relations hitherto summarized it has been concluded that changes in the calcium utilization are involved in the causation of antagonism (p. 189, 216). It must be considered as probable that these changes are at least partly due to alterations in permeability of the cell membranes (p. 250).

13. The relation of calcium absorption to dry matter production during two months of growth for the series without sodium was

of the anticipated simple form. For the series with sodium this relation was more complicated, which has been considered as an indication of internal actions involved in the causation of antagonism (p. 186).

14. It has been emphasized that the curves referring to ripened seeds are more similar to those of the entire immature plants, than to the curves of the mature tops (p. 233).

15. Neither the length of the longest shoot nor the length of the longest root was found to represent any appropriate criterion for growth (p. 193).

16. An account of an orienting experiment with sugar beets in sand culture is given. The results obtained appear to confirm the statement that similar relations as those found for oats, may hold good for the growth of sugar beets. The percentage of sugar in the roots did not seem to be affected by the various solutions (p. 243—244, 246).

17. The occurrence of grey-spot disease has been recorded and found to be correlated, in a certain measure, to the minima of dry weight production. The causation of the disease appears to involve also factors which have not been controlled in the experiments (p. 241—242).

18. The phyllonecrosis of sugar-beets appears to be related also to the amount of calcium and sodium in the nutrient solution (p. 245).

19. A short critical review of some literature dealing with permeability and antagonism is given in order to ascertain whether the conclusions of the present paper might be more theoretically elucidated by a comparison with other investigations. As the result was on the whole negative, it proves the need of limiting the discussion to an analysis of the quantitative data.

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BEITRÄGE ZUR KENNTNIS DER FORTPFLANZUNGSORGANE DER CAULERPA.

VON

TH. ARWIDSSON.

Bekanntlich gelang es Dostál im Jahre 1927 die Fortpflanzungsorgane von *Caulerpa prolifera* Lam. zu entdecken. In einer Reihe von Arbeiten hat er die Sache näher behandelt und die Verhältnisse nicht nur bei *C. prolifera,* sondern auch an der von ihm aus dem Mittelmeer neubeschriebenen Art *C. Ollivieri* und schliesslich auch kurz an der von Weber van Bosse in der Gegend von Celebes im Jahre 1888 gesammelten *C. peltata* Lam. var. *macrodisca* Dcne geschildert (Dostál 1927 *b,* 1928 *a, b,* 1929 *a—f).* Die Untersuchungen wurden in einer im Jahre 1929 erschienenen Arbeit (Dostál 1929 *b*) zusammengefasst.

Schussnig (1929 *a, b*) hat die Beobachtungen Dostáls im allgemeinen bestätigen können, und in der letzten Zeit haben W. und H. Schwartz (1930) einige ergänzende Beobachtungen mitgeteilt (vgl. auch Dostál 1929 *b*, S. 89, Fussnote).

Im Spätherbst 1929 übergab mir Herr Professor N. Svedelius sein in den Jahren 1902—1903 auf Ceylon und in Südindien gesammeltes, in Formalinspiritus aufbewahrtes *Caulerpa*-Material, um mir Gelegenheit zu geben nachzusehen, inwieweit diese Arten fertil seien. Infolge der Untersuchungen Dostáls — auf welche Prof. Svedelius schon am 23. Oktober 1928 in der »Botaniska Sektionen av Naturvetenskapliga Studentsällskapet i Uppsala» (vgl. Svensk Botanisk Tidskr. 1929, S. 159) die Aufmerksamkeit gerichtet hatte — war nämlich eine Nachprüfung des ceylonischen Materials nötig. Ja sogar durch die Untersuchungen Kuckucks über die Valoniaceen (Kuckuck 1907) war die Frage nach der Fortpflanzung der Cauler-

paceen in ein anderes Stadium gelangt, denn durch diese Untersuchungen hatte man neue Anregungen erhalten, wie und wo die eventuellen Fortpflanzungsorgane der Caulerpaceen zu suchen seien.

Im folgenden werde ich meine Beobachtungen vorlegen. Doch muss hervorgehoben werden, dass es sich oft unmöglich zeigte, brauchbare Mikrotomschnitte zu verfertigen, da ja das Material nur in Formalinspiritus aufbewahrt und also für solche Untersuchungen nicht fixiert war. Trotzdem die Beobachtungen schon aus diesem Grunde unvollständig sind, sollen sie mitgeteilt werden. Auch sei es mir gestattet, einige allgemeine Bemerkungen zu den Angaben und Erörterungen Dostáls und W. und H. Schwartz' zu machen.

Bevor ich zu meinen Beobachtungen übergehe, will ich Herrn Professor N. Svedelius für die Überlassung des Materials sowie für alle guten Ratschläge und Aufschlüsse meinen ergebensten Dank aussprechen.

I. **Beobachtungen an Caulerpa scalpelliformis (R. Br.) W. v. B.**

Von dieser Art, die von Svedelius (1906 *a*, S. 109) nur an einem Fundorte in Südindien (Paumben Pass) beobachtet wurde, liegt nur sehr spärliches Formalinspiritus-Material vor. Auf einem der Exemplare mit 13 Assimilatoren, welche im allgemeinen eine Länge von 1,3 cm bis 14,5 cm haben, wurde ein kleiner Assimilator von

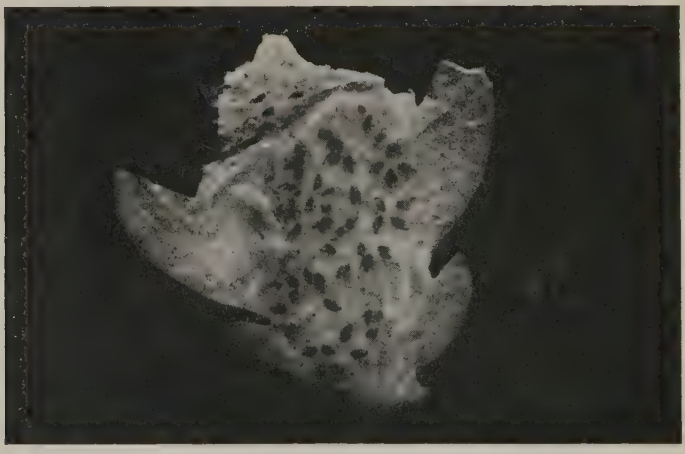
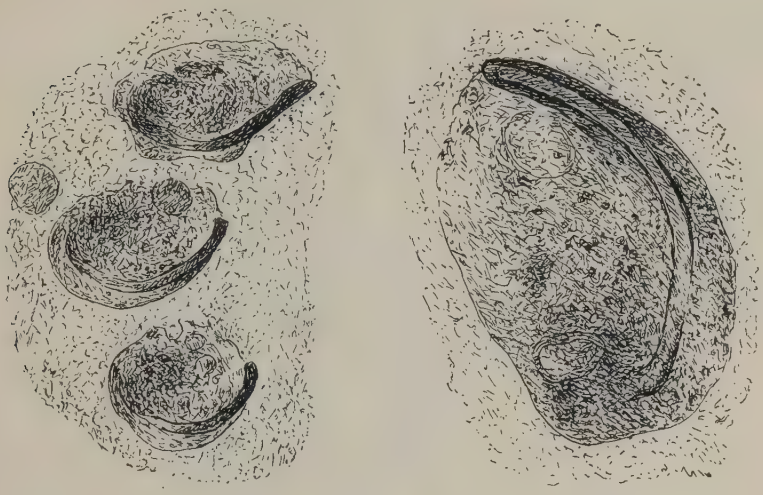


Fig. 1. *C. scalpelliformis*. Teil des Assimilators mit vielen Entleerungspapillen. Vergr. 4,2. — C. G. Alm photo.

nur 1,22 cm Länge angetroffen, der mit vielen Entleerungspapillen an der einen Seite versehen war (vgl. Fig. 1). Es muss hier bemerkt werden, dass auf *C. prolifera* nach Dostál (1929 *b*, S. 93) die Entleerungspapillen im Freien »meist auf beiden Seiten mehr oder weniger gleichmässig ausgebildet, wenn es sich um Blattspreiten oder -Stiele handelt» vorkommen. Von dem fertilen Assimilator der *C. scalpelliformis* war nur der basale Teil aufbewahrt. Nach den Ausführungen Dostáls darf man wohl behaupten,



a *b*

Fig. 2. *C. scalpelliformis*. *a*. Drei Entleerungspapillen. Vergr. 34. *b*. Eine der in *a* abgebildeten Entleerungspapillen bei 80facher Vergrösserung. — S. Ekblom et G. Boëthius del.

dass der ganze Assimilator fertil gewesen sei. Der Hauptteil dieses fertilen Assimilators soll demnach zugrunde gegangen sein.

Es muss hervorgehoben werden, dass mit Ausnahme dieses kleinen fertilen Assimilators alle Assimilatoren des Exemplars vollständig steril sind, ja, man kann sogar nichts beobachten, was als ein Schritt zur Fertilisierung gedeutet werden könnte.

Die sterilen Assimilatoren sind von normalem Aussehen mit »the arrangement of the protoplasm strings and of the chloroplasts, so characteristic of this species» (Svedelius, a. a. O., S. 111. Vgl. auch die dortige Figur). Der fertile Assimilator hat, wie aus meiner Figur 1 hervorgeht, etwa 50 Entleerungspapillen. Diese, deren näheres Aussehen aus Fig. 2 zu ersehen ist, sind recht verschieden

ausgebildet und oft von ziemlich unbestimmtem Umriss. Beim Vergleich mit den Abbildungen und Beschreibungen Dostáls (1929 *b*) betreffs der Entleerungspapillen der *Caulerpa*-Arten des Mittelmeers fällt auf, wie gebogen die Ausführungskanäle bei *C. scalpelliformis* sind.

Die Entleerungspapillen haben bei der letzten Art eine Länge von etwa 0,6 mm und eine Breite von 0,4 mm. Die entspre-

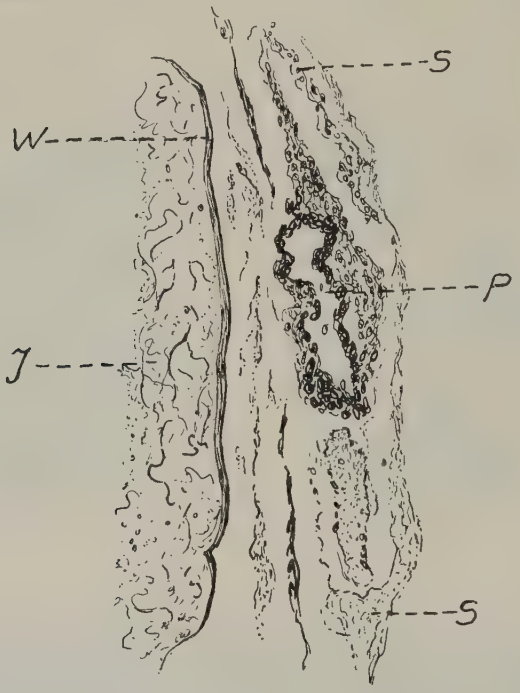


Fig. 3. *C. scalpelliformis*. Querschnitt durch eine Entleerungspapille (*P*). Die ausgedehnte Schleimhülle (*S*) mit vielen sekundär vorkommenden Schwärmern und Stärkekörnern ist deutlich zu sehen. *W* = Wand des Assimilators. *I* = Inhalt (d. i. Zellstoffbalken, Stärkekörner usw.) des Assimilators. Vergr. etwa 400. — G. Boëthius del.

chenden Masse sind nach Dostál (1929 *b*, S. 97) bei *C. prolifera* 0,65—0,90 (Länge), 0,05—0,12 (Breite an der Spitze und an der Basis), bei *C. Ollivieri* 1,65 (Länge), 0,13 (Breite), bei *C. macrodisca* schliesslich 1,3 (Länge), 0,3 mm (Breite). Die Papillen von *C. scalpelliformis* sind also im Verhältnis zu ihrer Länge auffallend breit.

Es ist mir gelungen, von den Papillen der *C. scalpelliformis* ziemlich brauchbare Mikrotomschnitte zu erhalten. Es ist jedoch

nicht möglich, die feineren Strukturverhältnisse wahrzunehmen. Ich muss mich daher hauptsächlich auf einen Hinweis auf die hier mitgeteilten Figuren 3 und 4 (und auf deren Erklärung) beschränken. Doch sei hervorgehoben, dass in den Querschnitten nicht nur dicht zusammengepackte, grosse Schwärmeranhäufungen vorhanden sind sondern auch kleinere Anhäufungen mit nur 2—3

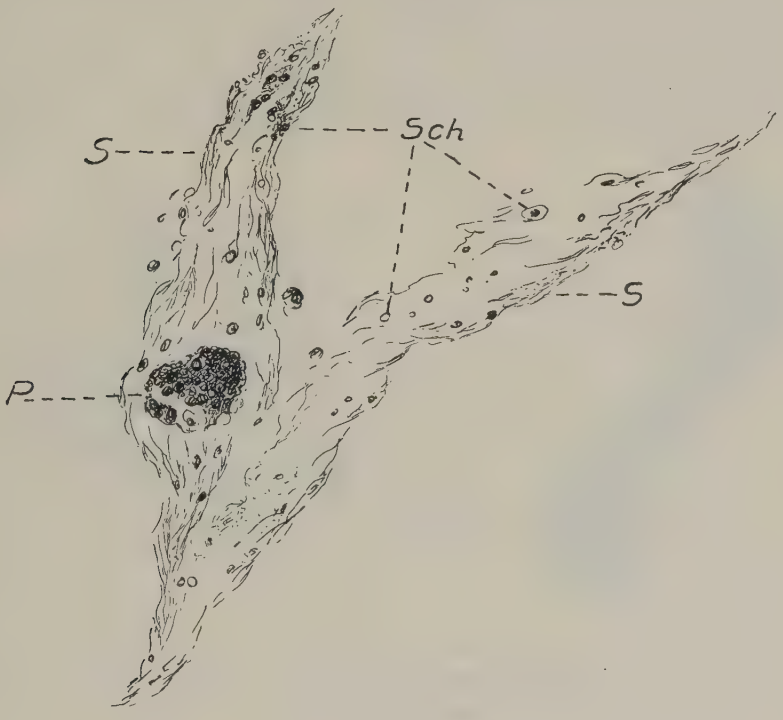
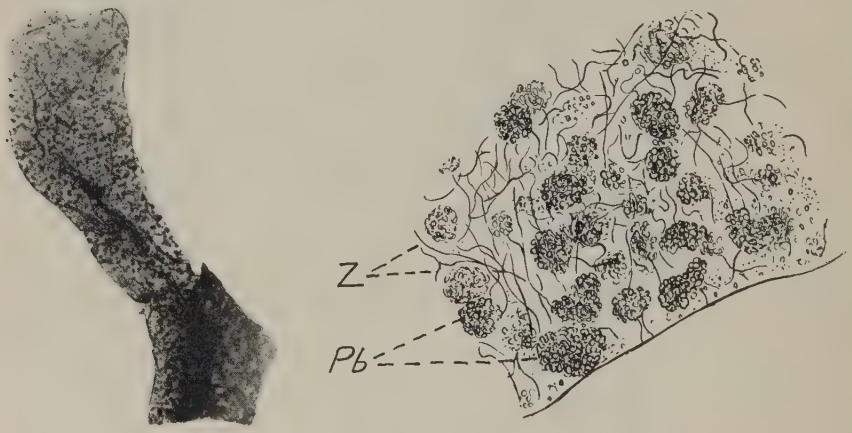


Fig. 4. *C. scalpelliformis.* Schwärmer (*Sch*) zerstreut in der Schleimhülle (*S*) um die Entleerungspapille (*P*) und in deren Inneren. Vergr. etwa 500. — G. Boëthius del.

Schwärmern, und dass sogar vereinzelte Schwärmer beobachtet werden. Alle diese Anhäufungen sind sicherlich als rein sekundäre Erscheinungen anzusehen. Entweder sind sie schon beim Fixieren oder bei der darauf folgenden Behandlung zwecks Verfertigung der Mikrotomschnitte entstanden. Das Wichtige besteht darin, dass es sich hier aller Wahrscheinlichkeit nach um Schwärmer (Gameten?) handelt.

II. **Beobachtungen an Caulerpa dichotoma Sved.**

Wie aus meiner Fig. 5 hervorgeht, habe ich bei dieser Art deutlich Protoplasmaballen (und Protoplasmaanhäufungen verschiedener Art) beobachtet — also nach den Erörterungen Dostáls einen der ersten Schritte auf dem Weg zu vollständiger Fertilisierung. Die Protoplasmaballen und Protoplasmaanhäufungen treten in mehr oder weniger ausdifferenziertem Stadium bei nahezu sämtlichen mir zur Verfügung stehenden Assimilatoren dieser Art hervor. Leider hat es sich als unmöglich erwiesen, gute Mikrotomschnitte zu erhalten, doch tritt durch Färbung mit Eisen-



a *b*

Fig. 5. *C. dichotoma*. *a*. Teil eines Assimilators mit vielen Protoplasmaballen. Vergr. etwa 6. I. und Th. Arwidsson photo. — *b*. Protoplasmaballen (*Pb*) und Zellstoffbalken (*Z*). Vergr. 155. S. Ekblom et G. Boëthius del.

hämatoxylin eine deutliche Neigung des Färbemittels hervor, sich in den Protoplasmaballen am längsten und am kräftigsten zu erhalten. Es kann meiner Meinung nach nicht bezweifelt werden, dass die zahlreiche Kerne, die in diesen Protoplasmaballen vorhanden sind, diejenigen sind, welche in späteren Entwicklungsstadien des Fertilisierungsganges dieser *Caulerpa*-Art Zoosporenkerne oder Gametenkerne werden sollen (vgl. Dostál 1929 *b*, S. 94), natürlich unter der Voraussetzung, dass die Fertilisierung bei *C. dichotoma* überhaupt so weit geht, dass Zoosporen (oder Gameten) gebildet werden. Hierüber wissen wir ja bis heute nichts. Trotzdem ich die Verhältnisse nicht mit Photographien und Zeichnungen

aus mikroskopischen Präparaten näher klarlegen konnte, schien es mir gut, die sehr deutlichen Protoplasmaballen dieser Art etwas näher zu behandeln, denn trotz mancher Andeutungen zu Protoplasmaanhäufungen habe ich bei keiner Art weder auf Material in Formalinspiritus noch auf getrocknetem Material so deutliche Fertilisierungsandeutungen wie bei *C. dichotoma* beobachtet. Die in der Literatur oft erwähnten Protoplasmaanhäufungen schienen oft — mit Ausnahme der in den Arbeiten Dostáls und Schussnigs behandelten — nicht so deutlich wie bei *C. dichotoma* zu sein. Es ist also schon das Vorhandensein von Protoplasmaballen eine ziemlich seltene Erscheinung.

III. **Beobachtungen an anderen Arten.**

Ausser dem, was ich bei *C. scalpelliformis* und *C. dichotoma* beobachtet habe, kann ich nur folgende Kleinigkeiten über die Fertilität der von mir untersuchten Caulerpaceen mitteilen.

1. Netzförmige Protoplasmaansammlungen, wie sie von Ernst (1918, S. 519) bei *C. racemosa* J. G. Ag. abgebildet werden, habe ich bei folgenden Arten aus Ceylon (Formalinspiritus-Material) beobachtet: *C. clavifera* C. Ag., *C. imbricata* Kjellm. und dessen f. *minor* Sved. Ausserdem habe ich bei getrocknetem Material von *C. filiformis* Harv. vom Kap der guten Hoffnung deutliche Protoplasmaballen beobachten können, und zwar sowohl an dem dürren Material als auch am Material, das in Milchsäure aufgekocht wurde.

2. Den von Dostál (1929 *b*, S. 117) näher geschilderten Zerfall der entleerten Pflanze habe ich an getrocknetem Material wiederzufinden versucht. Nun hat freilich Reinke (1900, S. 69) hervorgehoben, dass er »viele Tausende von Exemplaren, zu sehr verschiedener Zeit gesammelt» untersucht habe, wobei »an keinem Exemplare eine Andeutung von Sporenbildung wahrgenommen werden konnte». Reinke sagt weiter: »Selbst wenn sie, was ich erwarten möchte, nicht durch eine Querwand vom übrigen Zellenleibe abgetrennt wären und durch keine Anschwellung, keinen abweichenden Farbenton sich verrathen sollten, würde man sie an der abweichenden Konfiguration des Inhalts, besonders aber daran erkennen müssen, dass sie nach dem Austreten der Sporen leere Höhlungen von eigenartigem Aussehen darstellen müssen», und er fügt hinzu: »aber nichts von alledem vermochte ich zu finden und niemand hat etwas Derar-

tiges gesehen». In diesem Zusammenhang muss beachtet werden, dass Reinke (S. 70) die Beobachtung Weber van Bosses bei *C. macrodisca* nur als »einen nicht weiter aufklärbaren Reizzustand betrachtet».

Durch die erwähnten Untersuchungen Dostáls, denen auch eine Abbildung (Dostál 1929 *b*, S. 117) beigefügt ist, wird die Erscheinung klargelegt. Man kann in diesem Zusammenhang darauf hinweisen, dass Dostál betreffs *C. prolifera* und *C. Ollivieri* im Mittelmeer sagt (Dostál 1929 *b*, S. 88), dass »wahrscheinlich nicht wenige Beobachter die Pflanzen mit tausenden fertigen Schwärmern vor sich hatten, sie für pathologische, absterbende Pflanzen hielten und nicht näher beobachtet haben» (vgl. Schwartz 1930, S. 222). Dieses Zitat im Verein mit Äusserungen der anderen Arbeiten Dostáls über die relative Häufigkeit fertiler *Caulerpa*-Arten im Mittelmeer spricht meiner Meinung nach dafür, dass wir hier wirklich mit dem Endstadium der Fertilität, d. h. mit dem Zugrundegehen der Pflanze zu tun haben, und zwar wenigstens in einigen Fällen. Ich möchte bemerken, dass ich diese eventuellen Resultate der Untersuchung des getrockneten Materials nur kurz erwähnen wollte.

Ich habe zu konstatieren versucht, ob im Herbarium des hiesigen Botanischen Museums unter den *Caulerpa*-Arten derartige Erscheinungen zu sehen waren. Ohne eine absolut sichere Behauptung auszusprechen, sei hervorgehoben, dass es mir nicht ausgeschlossen scheint, dass unter den verzeichneten Arten entleerte Assimilatoren vorhanden sind. Es kann sich natürlich in gewissen Fällen auch nur um ein normales Zugrundegehen der Individuen handeln. — Da solche Untersuchungen an getrocknetem Material keine grössere Bedeutung haben können — über dasselbe liegen meist nur Vermutungen und nicht hinlänglich exakte Beobachtungen vor — so habe ich meines Erachtens keinen Anlass gehabt, das Material hier näher zu behandeln.

IV. **Allgemeine Bemerkungen.**

Trotzdem ich nur Gelegenheit gehabt habe, kleine Beobachtungen betreffs der Fortpflanzungsorgane der Caulerpaceen mitzuteilen, scheint es mir nicht überflüssig, hiermit einige Betrachtungen auf Grund unserer bisherigen Kenntnisse anzustellen.

1. Es ist ohne weiteres ersichtlich, dass die ausgebildete Fertilität bei den ceylonischen Caulerpaceen gewöhnlich nicht auftritt. Ich

habe mehr als 40 Gläser mit *Caulerpa*-Arten aus Ceylon durchgesehen, ohne mehr als zwei »fertile Proben» zu finden. Und diese gehörten gerade seltenen Arten an, von denen nur sehr spärliches Material vorhanden ist. Man erhält den Eindruck, dass es sich um Zufälligkeiten handle. Doch ist es möglich, dass die von mir gemachten Beobachtungen am Herbariummaterial darauf hindeuten, dass »Fertilität im weitesten Sinne» recht gewöhnlich ist. Man vergleiche Dostál (1929 *b*), der Schwärmer bei *C. prolifera* und *C. Ollivieri* ganz allgemein im Mittelmeer fand. Vielleicht kann es von einigem Wert sein, folgende Übersicht über die Zeiten, in denen das von mir untersuchte Material eingesammelt wurde, zu geben. Sämtliche Proben sind in Formalinspiritus aufbewahrt.

C. Chemnitzia (Esp.) Lam. 11.—12. Mai 1903.
C. crassifolia (C. Ag.) J. G. Ag. 20. Dezember 1902 und 14. Januar 1903.
C. dichotoma Sved. 9.—12. März 1903.
C. Fergusonii Murr. 3. April 1903.
C. Freycinetii C. Ag. 2. Mai 1903.
C. imbricata (Kjellm.). 29. Januar 1903.
C. laetevirens Mont. August 1903.
C. Lessoni Bory. Februar 1903 (leg. J. Hornell).
C. longistipitata (W. v. B.) Sved. 3. April 1903.
C. nummularia (Harv.) Reinke. Januar und 19. Februar 1903.
C. parvula Sved. Januar 1903.
C. peltata Lam. Februar 1903 und 11.—12. Mai 1903.
C. plumaris Forsk. 2. und 9. Mai 1903.
C. racemosa J. G. Ag. 29. April—6. Mai 1903.
C. scalpelliformis (R. Br.) W. v. B. 3. April 1903.
C. sedoides (R. Br.) C. Ag. 16. März 1903.
C. taxifolia (Vahl) W. v. B. 8. Januar und 9. u. 15. März 1903.
C. uvifera (Turn.) 11.—12. Mai 1903.

Schliesslich habe ich auch Material von *C. sedoides* (R. Br.) C. Ag., das im Torres Sund im August 1846 gesammelt wurde, untersucht.

2. Dostál sagt (1929 *b*, S. 105): »Bald nach der Papillenanlage wird auch die Bildung der Schwärmer vorbereitet». Mit dieser Vorbereitung zur Schwärmerbildung meint Dostál »eine feine Netzaderung . . ., die durch Anhäufung von chlorophyllhaltigem Protoplasma an den Wänden zustande kommt» und also die erste der verschiedenen Entwicklungsstufen zur totalen Fertilität darstellt. Demgegenüber muss hervorgehoben werden, dass ich weder bei *C. dichotoma* noch bei anderen Arten, wo Protoplasmaballen oder andere mehr oder weniger deutliche Heterogenitäten

von mir beobachtet wurden, Entleerungspapillen oder Papillenanlagen wahrnehmen konnte. Die Papillen sind also nicht zum Vorschein gekommen, auch wenn deutliche Protoplasmaanhäufungen vorhanden waren. In dieser Zusammenhang muss gesagt werden, dass nach Dostál (1929 *b*, S. 92) »ein ungestörtes Papillenwachstum nur einen Tag oder wenig mehr dauert», sowie dass die Zusammenhänge zwischen der Bildung und dem Vorhandensein von Prolifikationen einerseits und Papillen anderseits aus den Ausführungen Dostáls (1929 *b*) nicht klar hervorgehen.

Dostál (1929 *b*, S. 95) bildet »Übergangsbildungen zwischen Papillen und fadenförmige Prolifikationen» ab und (1929 *b*, S. 94) sagt, dass »eine abnorme Papillenbildung beobachtet wurde, die bloss auf die apikalen Teile solcher in Kultur entstandener Prolifikationen beschränkt war.» Nach Platzen dieser Gebilde, die eigentlich Übergangsbildungen zwischen den Papillen und den bekannten, bei niedriger Lichtintensität besonders im Winter reichlich entstandenen, fast fadenförmigen Blattprolifikationen vorstellen, trat eine beschränkte Portion des »Blattinhaltes nach aussen». Meiner Meinung nach muss ein wirkliches Unterschied zwischen den Funktionen der Papillen und der Prolifikationen vorhanden sein. Da man aus den Ausführungen Dostáls nicht erfährt, ob und in welcher Ausdehnung diese »Übergangsbildungen» eine Rolle als Ausführungspapillen der Schwärmer spielen, scheint es mir am besten anzunehmen, dass in gewissen Fällen nur eine rein äussere Gleichheit zwischen Entleerungspapillen und Prolifikationen vorliegt. Die Tatsache, dass Papillen auf Prolifikationen entstehen können (Dostál 1929 *b*, S. 94), beweist natürlich nicht, dass es sich um Bildungen identischer Art handelt, ebensowenig die Tatsache, dass die Schwärmer ohne Bildung von Papillen frei werden können.

In diesem Zusammenhang kann es zweckmässig sein, eine andere die Prolifikationen betreffende Frage zu behandeln. Man könnte behaupten, dass die Prolifikationen, wie sie z. B. von Prát (1924, Taf. I, Fig. 2) abgebildet werden, dadurch enstanden seien, dass die Schwärmer sich apogam im Inneren des Assimilators entwickelt haben (vgl. Schwartz 1930, S. 226). Es würden also Verhältnisse bestehen, die denen entsprechen, welche Dodel (1876) bei *Ulothrix* schildert. Es ist unmöglich, mit dem mir zur Verfügung stehenden Material eine solche Ansicht zu beweisen oder zu widerlegen. Für die Richtigkeit spricht auch die Figur bei Dostál (1929 *b*, S. 95, Abb. 3 B). Andererseits aber sollen bei den *Caulerpa*-Arten im

Mittelmeer Prolifikationen leicht gebildet werden (siehe z. B. Dostál 1928 *c*, S. 173, 177), vor allem ruft erhöhte Temperatur überall Prolifikationen hervor. Dostál sagt hierüber (1929 *e*, S. 642—643): »Steigt im März oder April die Temperatur des Meeres bedeutend, oder überträgt man die Pflanzen am Schluss des Winters ins Laboratorium, worin sie bei Zimmertemperatur gehalten werden, so brechen aus allen Teilen ohne Rücksicht auf die z. B. bei Herbstbeginn so ausgesprochenen Polaritätsverhältnisse zahlreiche, meist abnorme Blätter, die oft zylindrisch bleiben und sich reichlich meist dichotomisch, verästeln oder nur bandförmig werden». Schliesslich sei bemerkt, dass es theoretisch nicht ausgeschlossen ist, dass die Prolifikationen zweierlei Art sein können. Sie können nämlich teils nur rein vegetative Sprossungen darstellen, teils aber aus sich apogam entwickelnden Schwärmern hervorgehen.

3. Dostál (1929 *b*) hat grosses Gewicht darauf gelegt, dass die Fertilisierung aller Assimilatoren zu gleicher Zeit vor sich geht, auch wenn grosse Exemplare vorhanden sind. »Auch alle Rhizome, die zusammen mehr als 50 Tragblätter, jedes mit 2—5 Prolifikationen trugen, . . . zeigten Schwärmerbildung zu gleicher Zeit», sagt er (1929 *b*, S. 112). Wenn nicht das ganze Exemplar fertil wird, so gehen erst seine fertilen Teile und dann die übrigen zugrunde (Dostál 1929 *b*). Es handelt sich also nach Dostál um »physiologisch vollständige Holokarpie». Weiter wird hervorgehoben, dass »der Impuls zur Umwandlung steriler Pflanzen in fertile von den Rhizomen» ausgehe (Dostál 1929 *b*, S. 112). Dies soll durch Versuche und Beobachtungen bestätigt werden.

Nun ist zuerst hervorzuheben, dass das ganze Exemplar von *C. scalpelliformis* steril war, jedoch mit Ausnahme eines kleinen 1,2 cm langen, fertilen Sprossenteils (vgl. näher oben, S. 265). Die bei *C. prolifera* und *C. Ollivieri* im Mittelmeer beobachtete Gleichzeitigkeit der Fertilisierung gilt also nicht generell. Bei *C. dichotoma* sind nun alle Assimilatoren, die ich zu untersuchen Gelegenheit gehabt habe, mit den für beginnende Fertilität charakteristischen kleinen Protoplasmaballen versehen (vgl. oben S. 268). In diesem Fall ist also wenigstens in dem beobachteten frühen Entwicklungsstadium eine Gleichzeitigkeit zu konstatieren.

Was nun die Frage nach dem Impuls zur Fertilisation betrifft, so scheint mir die ganze Sache von Dostál übertrieben worden zu sein, denn oft ist diese Gleichzeitigkeit der Fertilität bei anderen Pflanzenarten vorhanden, und es handelt sich nicht um etwas für *Caulerpa*-Arten speziell Charakteristisches. Es ist ganz überflüssig,

hier besonders mit hormonalen Impulsen zu laborieren (vgl. Dostál z. B. 1929 *b*, S. 113). Dies soll durch folgendes Beispiel näher erläutert werden. Die Blüte eines Lindenbaums mit seinen Tausenden und aber Tausenden von Blüten im Lindenwald, der aus Hunderten von Bäumen besteht, entwickelt sich im grossen und ganzen gleichzeitig. Diese alltägliche Erscheinung ist viel merkwürdiger als die entsprechende Erscheinung bei *Caulerpa*-Arten. Die Tatsache, dass die letztgenannte Pflanze grobmorphologisch eine einzige Zelle ist, der Lindenbaum dagegen ungeheuer vielzellig, spricht wohl für eine einfachere Erklärung im ersten Falle als im zweiten und nicht umgekehrt. Es handelt sich überhaupt um Probleme, die sicherlich an dazu mehr geeigneten Pflanzen zu lösen sind. Erst dann dürfte man meines Erachtens *Caulerpa*-Arten in die Diskussion mit einbeziehen können.

4. Besonders problematisch erschienen mir die Gebilde, die Dostál (1929 *e*, S. 645 u. f.) unter den Namen »Kernfusionen», »fusionierte Kerne» oder »Fusionskerne» erwähnt. Diese Gebilde, die durch Verschmelzung aus wenigstens 25 oder noch mehr einfachen Kernen entstanden sein sollen, unterscheiden sich von Chloroplasten und kleineren Stärkekörnern, denen sie nach Dostál (1929 *e*, S. 646) in Form und Grösse ähneln, dadurch, dass sie bei Färbung »wie normale Kerne den Farbstoff noch behalten, wenn die sie umgebenden Chloroplasten und die Zellstoffbalken sowie die Kutikularschichte schon völlig frei davon gewesen sind». Dass Übergänge zwischen Fusionskerne und normale Kerne selten zu beobachten sind, soll darauf deuten, dass die Entstehung der Fusionskerne rasch erfolgt. Dostál selbst hebt hervor (1929 *e*, S. 647), dass die Frage betreffs der Fusionskerne näher zu untersuchen ist, und betont, dass es sich um eine ganz neue Erscheinung handelt. Doch teilt Dostál mit, dass Němec »in zentrifugierten Cladophoren» bei noch nicht publizierten Untersuchungen dieselbe Erscheinung wahrgenommen hat. Vgl. übrigens im allgemeinen Tischler (a. a. O.).

Ohne hier auf weitere Einzelheiten einzugehen, muss gesagt werden, dass es überhaupt nötig ist, den inneren Bau der Caulerpaceen zu studieren, denn trotz der grossen Zahl von Arbeiten über *Caulerpa*-Arten ist noch keine erschienen, die über ihren Bau zufriedenstellende Aufschlüsse und hinlänglich gute Bilder bringt (vgl. Dostál 1926). Die Abbildungen Dostáls (vgl. z. B. 1929 *b*, 1929 *e*) sind sehr schematisch und widersprechen einander zum

Teil. Es ist daher unmöglich, sich mit Hilfe des Textes ein gutes und klares Bild der Verhältnisse zu verschaffen. Sicherlich muss man sich bei neuen Untersuchungen u. a. der Beobachtungen erinnern, laut welchen »die Stärkekörner bei *Caulerpa* nicht in Chloroplasten, sondern in besonderen Organzellen, die man als Leukoplasten auffassen muss, entstehen» (Czurda 1928, S. 201). Diese Stärkeabscheidung a u s s e r h a l b der Chloroplasten ist nach Czurda (S. 198) unter den Chlorophyceen eine seltene Erscheinung und ist nur bei *Udotea*-Arten, *Derbesia neglecta* (aber nicht bei anderen *Derbesia*-Arten), *Dichotomosiphon tuberosus* und *Caulerpa prolifera* beobachtet worden.

Beim Studium des Inhaltes der *Caulerpa*-Energide sollen natürlich auch jetzt so wie früher die Protoplasmamobilisationen Beachtung finden. In dieser Zusammenhang ist es auch sicher angezeigt, sich einiger Erörterungen Dostáls zu erinnern: Es gibt zwei Arten von Protoplasma, »eine stabile, chlorophyllfreie, die an ihrem Ort verbleibt, gleichgültig ob sie in Ruhe ist oder strömt, und eine instabile, chloroplastenhaltige, die weitgehend verschiebbar ist» (Dostál 1929 *e*, S. 663). Die Ausführungen Dostáls, scheint es mir, kann man am einfachsten folgendermassen zusammenfassen. Der normale Verlauf der Protoplasmamobilisation ist: Assimilator → Assimilatorstiel → Rhizom, der erste Schritt zur Fertilisierung ist dagegen durch die entgegengesetzte Strömung, also Rhizom → Assimilatorstiel → Assimilator, gekennzeichnet.

5. Dostál sagt (siehe z. B. 1929 *b*, S. 89 u. 138), dass die Caulerpaceen durch die festgestellten Fertilitätsverhältnisse nahe verwandtschaftliche Beziehungen zu den Valoniaceen aufweisen. Ein Vergleich mit den von Kuckuck untersuchten Arten *Valonia macrophysa* Kütz., *V. utricularis* (Roth) C. Ag. und *V. aegagropila* C. Ag., sämtliche aus dem Mittelmeer, zeigt, dass dies der Fall ist. Dagegen gilt dies nicht betreffs *Halicystis ovalis* (Lyngb.) Aresch., denn diese Art zeigt ja nach Kuckuck die Erscheinung, dass dasselbe Individuum mehrere Fertilisierungen durchlaufen kann und dass die Öffnungen, durch welche die Zoosporen ins Freie gelangen, sich schliessen — »und die freie Räume werden von neuem mit Chlorophyll ausgefüllt» (Kuckuck 1907, S. 46). Nun bin ich nicht der Ansicht, dass die Verhältnisse bei *Halicystis* gegen eine Verwandtschaft zwischen Caulerpaceen und Valoniaceen sprechen, ich habe nur darauf hingedeutet, man dürfe nicht vergessen, dass die Verhältnisse der Familie der Valoniaceen nicht einheitlich sind.

Es ist weiter zu erwähnen, dass die von Ernst (1918, S. 519) abgebildeten Plasmaanhäufungen der Assimilatoren der Caulerpaceen — Erscheinungen, die ich bei einigen Arten wiedergefunden habe — grosse Übereinstimmung mit den Abbildungen von Makro- und Mikrozoosporensammlungen bei *Halicystis ovalis* in der Arbeit von Kuckuck (1907, S. 6 u. 8) aufweisen.

6. Es mag darauf aufmerksam gemacht werden, dass unter den alten und recht zahlreichen Beobachtungen und Erwähnungen über Protoplasmaheterogenitäten und weitere Entwicklungsschritte die Arbeit von Prát besonders wichtig ist. Er bildet nämlich (1924, Taf. 1, Fig. 2) einen Teil eines *Caulerpa*-Assimilators mit vielen Protoplasmaballen ab. In der Erklärung der Figuren schreibt Prát nur: »A leaf with many proliferations». Das ist auch sehr deutlich, aber nicht das Wesentliche. Ich habe die Arbeit Práts hier erwähnen wollen, da Dostál die Arbeit zitiert, jedoch ohne — soweit ich finden kann — die erwähnte Figur Prats zu behandeln.

7. Versuche, die in Kulturen gemacht worden sind, um Kopulationen zwischen Schwärmern zu erhalten, sind bisher negativ ausgefallen (Dostál 1926 *b*, S. 123; Schwartz 1930, S. 226). In der Erklärung der Figuren und im Text, der das eventuelle Vorhandensein einer Kopulation behandelt, hat Dostál nicht klar zwischen Doppelschwärmern und Kopulationsprodukten unterschieden (1929 *b*, S. 119, 122, 125), sondern verwendet die beiden Ausdrücke abwechselnd. Alle Betrachtungen betreffs dieser Verhältnisse (Schwartz 1930, S. 226) sind demnach als verfrüht anzusehen.

8. Die Bezeichnung Holokarpie (Dostál 1929 *b*) soll ja darauf hindeuten, dass die ganze Pflanze bei der Fertilität zugrunde geht; besser wäre wohl der Ausdruck »Holosporie» oder »Hologamie» gewesen. Nun scheint aber aus meinen Beobachtungen an *C. scalpelliformis* hervorzugehen, dass sich nicht alle Arten wie *C. prolifera* und *C. Ollivieri* verhalten, m. a. W. das Zugrundegehen des ganzen Individuums bei der Fertilität ist nicht für alle Arten charakteristisch. In diesem Zusammenhang muss auch darauf hingedeutet werden, dass Schwartz (1930, S. 225) sagt: »Pflanzen mit geöffneten Papillen starben nicht so schnell wie es nach der Darstellung Dostáls zu erwarten gewesen wäre».

9. Ausser dem, was ich an verschiedenen Stellen vorliegender Studie über die Arbeit von W. u. H. Schwartz angeführt habe, soll hier folgendes gesagt werden.

Beide Verfasser nehmen überhaupt einen sehr kritischen Standpunkt gegen die Angaben Dostáls an, ihre Vermutungen über Bakterieninfektionen (S. 222) müssen sie aber selbst als unwahrscheinlich aufgeben. Die Vermutung (S. 227), »dass die Schwärmer in den Entwicklungsgang einer im *Caulerpa*-Thallus parasitisch lebenden Alge gehören», muss wohl als unwahrscheinlich betrachtet werden, denn warum sollte die *Caulerpa*-Pflanze Entleerungspapillen für einen ihrer Parasiten ausbilden? In diesem Zusammenhang muss auf Schwartz' Beobachtungen beim Übertragen von *Caulerpa*-Pflanzen in verdünntes Seewasser hingedeutet werden. Er sagt (S. 220): »Es treten dann an der Spitze oder an Knickstellen der Proliferationen Plasmaergüsse auf, die denselben Bau zeigen wie die Köpfchen der Dostálschen Papillen».

V. Zusammenfassung.

1. Aus dem Material von *Caulerpa*-Arten, das Professor N. Svedelius auf Ceylon im Jahre 1903 gesammelt und in Formalinspiritus aufbewahrt hatte, wurden Entleerungspapillen und Schwärmer (Schwärmeranhäufungen) bei *C. scalpelliformis* (R. Br.) W. v. B. und das Auftreten von »Protoplasmaballen» bei *C. dichotoma* Sved. beschrieben und abgebildet.

2. Hauptsächlich im Anschluss an die Ausführungen Dostáls (Dostál 1927 *b*, 1928 *a, b,* 1929 *a—f*) wurden einige kritische Bemerkungen vorgebracht. Diese betrafen sowohl den Zeitpunkt der Entstehung der Entleerungspapillen als auch die Übergangsbildungen zwischen Papillen und Prolifikationen. Ferner wurden die Fertilisierung des ganzen Exemplars oder nur eines Teiles desselben sowie die fusionierten Kerne behandelt (vgl. Dostál 1929 *e*, S. 645 u. f.). Schliesslich wurden die verwandtschaftlichen Beziehungen zwischen Caulerpaceen und Valoniaceen kurz erörtert. Zuletzt wurde hervorgehoben, dass man zwischen Doppelschwärmern und Kopulationsprodukten scharf unterscheiden muss, und dass der Ausdruck »Holokarpie der Caulerpaceen» als ungenügend und nunmehr wohl auch als fehlerhaft anzusehen ist.

Der kritische Standpunkt von W. und H. Schwartz wird ebenfalls kurz behandelt.

Uppsala, Botanisches Institut der Universität, im März 1930.

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CONTRIBUTION TO THE DRABA FLORA OF GREENLAND. II.[1]

BY

ELISABETH EKMAN.

With Plate III.

Draba daurica DC.

Syn. *D. caule ramoso folioso foliis dentatis.* L. Fl. Lapp. p. 211 (ex. schedula in Herb. Burman); *D. daurica* DC Systema II (1821) p. 350, Prodr. I (1824) p. 170; Ledebour Fl. Ross. I (1842) p. 153; Turcz. Cat. Pl. Baic.-Dah. N:o 144; N. Busch Fl. Sib. III (1919) p. 355 pro parte; E. Hultén Fl. Kamtchat. II (1928) p. 161. *D. hirta* Zetterstedt (non L.) Resa II (1822) p. 24 & 44; Torrey and Gray Fl. North Am. I (1838) p. 105 pro parte; Hartman Sk. Fl. ed. 3 (1838) p. 153, ed. 4 (1842) p. 210 pro parte; W. J. Hooker Fl. Bor. Am. (1840) p. 53?; E. Fries Sum. Veg. Scan. (1846) p. 150; S. Berggren in Sv. Vet. Akad. Öfvers. 27. b. 1 (1870) p. 1011 pro parte; Kjellman et Lundström in Vega-Exped. vetensk. iakt. (1882) p. 309 pro parte; O. Gelert in Bot. Tidsskr. XXI 3 (1898) p. 305 pro parte; P. Dusén in Bih. Sv. Vet. Akad. Handl. XXVII 3 (1902) p. 305 pro parte; Chr. Kruuse Bot. Explor. East coast Greenl. V (1905) p. 163 pro parte; VI (1906) p. 234 pro parte; N. Hartz and Chr. Kruuse Veget. Northeast Greenl. (1911) p. 359 & 409 pro parte; A. Lundager Veget. of Germania Land, North-East Greenl. (1912) p. 25; N. Busch Fl. Sib. III (1919) p. 349 (var. *genuina*); M. P. Porsild Fl. Disko Isl. (1920) p. 88 pro parte; Pohle Drab. Asiat. in Fedde Repert. Beih. XXXII (1925) p. 35 pro parte; O. E. Schulz Cruciferae-Draba et Erophila in Englers Das Pflanzenreich (1827) p. 267. *D. hirta* a *leiocarpa* Lindblom in Bot. Not. (1839) p. 52; Linnaea XIII (1839) p. 330, Vet. Akad. Handl. f. 1839 (1841) p. 66; Th. M. Fries in Bot. Not. 1873 p. 5; Lange Consp. Florae Groenl. (1880) p. 42; A. Berlin in Vet. Akad. Öfvers. 41 7 (1884) p. 24. *D. hirta elatior* a *leiocarpa* A. Blytt Fl. Norveg. III (1876) p. 986; O. Dahl Blytts Fl. p. 383 p. p. *D. hirta borea* C. H. Ostenfeld Fl. Greenl. and its origin. Dansk. Vid. Selsk. Med. VI 3 1926; Elis. Ekman in Hultén Fl. Kamtch. II p. 161. *D. incano-hirta* C. Hartman Sk. Fl. ed. 11 (1879) p. 206 pro parte. *D. subam-*

[1] Continuation from Sv. Bot. Tidskr. vol. 23, 1929, p. 476—495.

plexicaulis C. A. Meyer in Ledebour Fl. Altaica III (1831) p. 77. *D. henneana* Schlechtendahl in Linnaea X (1836) p. 100. *D. rivularis* Hornemann ex Steudel Nomencl. ed. 2, pars I (1840) p. 528. *D. magellanica* * *borea* (ad interim) Elis. Ekman in Sv. Vet. Akad. Handl. B. 57 n:o 3 (1917) p. 44; Lindmans Fan. Fl. ed. 1 (1918) p. 290; M. P. Porsild Contrib. Fl. Westgreenland (1926) p. 177.

Icon. Fl. Ross. Alt. tab. 265 (*D. subamplexicaulis*). Sv. Bot. B. 11 tab. 768 fig. 1 a & b; Reichenbach Pl. Criticae tab. 8 fig 1026—28; Exs. Herb. Norm. fasc. 3. N:o 23; Gelert Not. Arct. pl. p. 304 fig. 15 (*D. hirta*). Elis. Ekman Zur. Kennt. Nord. Hochgebirgs Drabae tab. 2 N:o 6, tab. 3 *c. d.* et *e.* (*D. magellanica* * *borea*). N. Busch Fl. Sib. III p. 354 (*D. hirta*), p. 357 (*D. daurica*). O. E. Schulz Cruciferae-Draba et Erophila Fig. 29 p. 268 (*D. hirta*).

1. A taxanomical question.

I may be asked why I do not use the name of *D. hirta* for the plant in question instead of *D. daurica*, which is a younger nomenclature. I shall now try to give an answer to this question. In Linnæus' Herbarium in the Linnean Society in London there are two specimens which are labelled »*hirta* Lapp.(onia)». On the back of the sheet of paper Linnæus has written with his own hand »*Cardamine foliis obtusis sessilibus ad radicem in rosulam dispositis, siliquis brevibus* Gmel.». This quotation is from Flora Sibirica by Gmelin vol. 3 (1763) p. 272, where a *Draba* is reproduced in fig. 66 n:o 3. Under this quotation Smith has appended the word »vix» which of course refers to the identity between the *D. hirta* of Linnæus and the plant which is represented in Flora Sibirica (Gmelin's plant is identical whith *D. daurica*. Cf. Schulz Cruciferae-Draba et Erophila p. 269 sub »*D. hirta*»).

One of the specimens labelled *D. hirta* is *Braya glabella* Richards. (The genus *Braya* was not yet distinguished at the time of Linnæus.) The other plant is a *Draba*, but this form does not occur in Scandinavia. It is identical with *D. gelida* Turcz. or *D. ochroleuca* Bunge var. *gelida* (Turcz.) N. Busch, a plant which is indigenous in Sibiria. The locality on the label of *D. hirta* as also the note in Fauna Suecica 2 app. p. 557 to the effect that *D. hirta* was collected by Solander in 1756 during his exploring tour in Pite Lappmark and Norway must therefore be referred to the *Braya* specimen.

The true *Draba* specimen has only one bracteal leaf on its glabrous stem and the leaves of the rosella have no other pubescence than cilia. In reading the diagnosis given by Linnæus in Species

Plantarum 2 vol. 2 p. 897 the conviction is borne in upon one that it is *D. gelida* which he had in view. It runs as follows: »Draba scapo unifolio foliis subhirsutis siliculis obliquis pedicellatis. Simillima *D. incanae* sed caulis nudis in medio folio unico lanceolato. Petala alba emarginata. Siliculae magis glabrae ovatae pedunculo siliqua dimidio breviore nec subsessiles». It must be observed that »in medio folio unico» indicates that the leaf is a bracteal one. In the Scandinavian *Drabae* a single cauline leaf is always situated on the lower part of the stem nearer to the rosella, if it is not a bracteal one under a pedicel.

But fancy, I hear somebody say: The *D. hirta* specimen which is represented by Schulz l. c. has only one cauline leaf which is situated on the upper part of the stem. That indeed would be an anomaly. But in point of fact, the reproduction has been made from a defective specimen which had lost one of its cauline leaves, as I have been able to ascertain in the Berlin Herbarium.

As the *Draba* specimen of Linnæus is a fruit specimen, he must have described the white colour from the *Braya* specimen. A very plausible explanation is that Linnæus had received the *D. hirta* from Gmelin (whom he quotes), and, considering it to be identical with the plant which Solander had collected in Lapland, had mounted them on the same sheet of paper. Nor did other botanists after Linnæus such as A. P. De Candolle (Prodromus I p. 169) and Hartman fil. observe the difference between the two plants. The latter writes (Anteckningar till de skandinaviska växterna i Linnés herbarium. Vetensk. Akad. Förhandl. 1853 p. 269) »Omnino est *D. hirta*».

As *D. gelida* was not found in Scandinavia, the name of *D. hirta* was applied to the *Draba* which the diagnosis best fitted, viz. *D. rupestris* R. Br. This plant in many cases has not more than 1—2 cauline leaves or is devoid of them altogether.

Gunnerus, a contemporary of Linnæus and the author of Flora Norvegica, in giving the diagnosis of *D. hirta* merely quotes Linnæus »in medio folio unico», whereas he described the new species *D. norvegica* as being provided with »foliis caulinis paucis». From a photograph of a specimen of *D. hirta* in the Herbarium of Gunnerus in Trondhjem taken by Mr. J. Lid in Oslo it must be inferred that this specimen is a form of *D. rupestris*. In reply to my inquiry regarding the pubescence of the plant, Mr. Lid stated that, as far as he could recollect, the plant had a heterotri-

chous pubescence on the radical leaves. »In any case it was not the dense pubescence of stellulate hairs such as in *D. magellanica* (*D. arctica* J. Vahl).»

In the Stockholm Herbarium there are two specimens which were collected by Linnæus' pupil Montin in 1749 in Lule Lappmark and which are labelled »*D. hirta*». These are also forms of *D. rupestris*. Wahlenberg, having found a taller variety of this species, subsp. *inferalpina*, described *D. hirta* as having two cauline leaves (Fl. Lapp. p. 175) or »foliis caulinis subbinis» (Fl. Suecica p. 415).

J. W. Zetterstedt (1822) was the first to refer the tall form with three or four cauline leaves to *D. hirta*. This form is distinguished from *D. rupestris* by a mere pubescence of stellulate hairs on the leaves (the number of the cauline leaves varies, however, from one to five). But Wahlenberg does not seem to have given much faith to the observations made by Zetterstedt, as he does not quote him in Flora Suecica with reference to *D. hirta* or any *Leucodraba*, but merely with reference to *D. alpina*, a plant with yellow flowers about which nobody could make a mistake.

E. A. Lindblom, the monographist of the genus *Draba*, applied the name of *D. hirta* to the tall plant discovered by Zetterstedt. This form is moreover reproduced under the same name in Plantae Criticae by H. G. L. Reichenbach and represented in Herb. Normale by E. Fries. C. J. Hartman, the author of Skandinaviens Flora and a contemporary of Lindblom, on the other hand believed that the *D. hirta* of Linnæus was identical with *D. scandinavica*, a new species established by Lindblom but subsequently referred by him to *D. rupestris* R. Br. (Bot. Notiser 1841 p. 117). Hartman based this view upon the fact that the then existing specimens of *D. hirta*, collected by Solander, in the Stockholm Herbarium were small specimens. (The are now lost, but were probably specimens of *Braya*.) In answer to Hartman's objection, Lindblom expressed the view (l. c. p. 120) that Linnæus had chosen the tallest plants for himself and left the small ones. Though Hartman and Lindblom differed in opinion as to which plant should be named *D. hirta*, they agreed in the view that the type in Linnæus' Herbarium was a decisive factor as to the nomenclature.

The Bibliothèque Delessert in the Bibliothèque de l'Institut de France contains a collection of plants which was presented by

Linnæus to his Dutch friend, Burman. These plants were collected during his tour in Lapland in 1732. There is found among them a tall *Draba*, identical with those which have been described by Zetterstedt as having 3—4 cauline leaves. It is labelled: »*caule ramosi foliosi foliis dentatis*». This diagnosis shows that Linnæus had *D. incana* in view (cf. Flora Lapp. p. 211). In a description of this above mentioned collection of Linnean plants, Th. M. Fries states, that also Wahlenberg had the same view about the systematical position of this tall *Draba* with several cauline leaves. (Anteckningar rörande en i Paris befintlig Linnéansk växtsamling. Vetensk. Akad. Öfvers. 1861 p. 265.)

It should be noted in this connection that the pods of the specimen in Paris are quite glabrous, the cauline leaves denticulate and the stem somewhat branched at the top (cf. Zur Kenntnis . . . I p. 16). I had the opportunity of examining it closely on a visit to Paris in 1926.

In the Berlin Herbarium there are specimens of the same *Draba* which, according to tradition, belonged to Beckmann, the German pupil of Linnæus, and were received from the latter. The tallest specimen has three cauline leaves. They are labelled *D. hirta* but not in Linnæus' hand and there is nothing to indicate that the determination was made by him. It may quite as well have been made by Beckmann himself. These specimens cannot therefore be regarded as types. Schulz moreover informs us (l. c. p. 222) about some specimens of »*D. norvegica*» (= *D. rupestris*) var. *glabrata* »ex. Herb. Beckmann» in the Berlin Herbarium which had likewise emanated from Linnæus. These specimens were doubtless also labelled *D. hirta*, as at that period no other name was known for such small Scandinavian individuals of *Leucodraba*.

We see from the facts related above, that the name of *D. hirta* was given to no less than four different plants. The one which the diagnosis least fits is the tall *Draba* with several cauline leaves which is identical with *D. daurica* DC. This plant cannot therefore be named *D. hirta*. As already mentioned, I was long in doubt about the identity between *D. daurica* and *D. hirta* as *D. daurica* in Flora Sibirica . . . III p. 355 by N. Busch is described as having »filamenta non dilatata». But having found that the type specimen in Herb. De Candolle in Geneva has broadly dilated filaments, I am now convinced of their identity. Larger flowers are also attributed to *D. hirta*, but the size of the flowers

is a character which varies in relation to the soil where the plant grows and other ecological conditions. Specimens with flowers smaller than those of the type specimen of *D. daurica* were collected under the name of *D. hirta* by T. Alm in 1901 at Karmokola in Nova Zembla. Such small specimens were also collected by K. A. G. Gredin in 1900 in East Greenland.

2. Draba daurica and its varieties.

Draba daurica DC.

Planta perennans ± dense caespitosa, tamen laxior quam in speciebus praecedentibus (*D. cinerea, D. groenlandica, D. Ostenfeldii*). Caules 8—35 cm alti adscendentes—suberecti simplices—subramosi, in inferiore parte saepe pilis longis simplicibus ramosisque vestiti, in superiore parte pilis brevioribus diversis praediti vel glabri. Folia basalia in rosulum congesta, integra—subdentata, lanceolato-oblonga, in petiolum attenuata, apiculata, 7—30 mm longa, 3—7 mm lata, pilis brevibus stellatis vestita sed interdum glabrescentia. Folia caulina 1—5 (6), ovato-lanceolata—oblongo-lanceolata, sessilia, 8—16 mm longa, 2—5 mm lata, interdum subamplexicaulia, uni—tridentata (in speciminibus pumilis interdum integra), omnia pilis stellatis vestita (f. *typica*) vel unum alterumque folium caulinum pilis simplicibus ± complete ciliatum (f. *occidentalis*). Inflorescentia floribus 4—19 corymbosa fructifera, in f. typica racemosa. Petala lactea, obovato—cordata, emarginata unguiculata, cum ungue 3—5,5 mm longa, 2—4 mm lata; sepala dimidio breviora, laete viridia, in dorso pilis simplicibus praedita vel glabra, in margine membranacea. Filamentum staminis ad basin dilatatum. Pedicelli subrecti—patuli (in speciminibus groenlandicis potius magis patulis quam in scandinavicis), pilis plurimis simplicibus ± sparse praediti vel glabri, quam siliculas ovato-oblongas—anguste oblongas 8—15 mm longas, 2—3,5 latas, glaberrimas breviores, infimi interdum aequilongi. Semina 9—17 in quoque loculo, anguste ovata, saepe subdepressa, fusca. Stylus brevis sed manifestus. Chromosomata haploidea 32.

Var. *lutescens* nov. var. Petala sulphurea, sepala initio violaceo—atroviridia, demum saturate viridia. Ceterum ut in f. typica.

Var. *rupestriformis* nov. var. Inter folia radicalia folium unum alterumque pilis simplicibus ciliatum. Forma probabiliter inter *D. dauricam* et *D. rupestrem* hybrida.

f. *condensata* (= *D. hirta* γ *condensata* Lange) »Multicaulis, caulibus crassiusculis 4—6 l. stricte erectis; inflorescentia jun. capitata, fructifera thyrsoideo-contracta; siliculis glabris, patulis, pedicello subduplo longioribus.» (Conspectus Florae groenlandicae p. 43.)

f. *brachycarpa* nov. f. Planta dense caespitosa. Racemus fructifer ± contractus. Siliculae ovato-ovales—ovato-oblongae, 7—11 mm longae, 2,5—4,5 mm latae, pedicellos inferiores subaequantes, superiores superantes. Semina ovalia, circiter 1 mm longa, fusca, in latera non depressa.

Most plants vary in size according to the environmental conditions under which they grow. Thus the same plant acquires different habits in a moist shady place or in a dry soil. Few plants, however, show such great variations as *D. daurica* DC. The type specimen from Dahuria in Herb. De Candolle in Geneva is of a medium size; probably it comes from a dry locality, as the flowers are small, the petals only being 3 to 4 mm in length. Analogous specimens are found both in the northern part og Scandinavia and in Greenland, but also taller specimens occur in these areas, especially in Scandinavia. High branched individuals have been collected in West Greenland: at Paratok by Ussing in 1886, at Ritenbenk by Hartz in 1900 and on the Ameralik Fjord in 1835 by J. Vahl. A similar specimen is collected in East Greenland on Scoresby Sound in 1902 by N. Hartz.

The smallest specimens which I have seen are derived from Karmakola in Nova Zembla, collected there in 1901 by T. Alm, and from East Greenland (Muskoxfjord, Mackenzie Bay), collected there in 1900 by K. A. G. Gredin. They are slender, only about 8 to 12 cm high and have very small flowers, petals being only about 3 mm in length. The pubescence on the leaves, which in the genus *Draba* is the most constant character, is of course always of the same kind — in *D. daurica* stellulate — but it may be more or less dense according as the hairs are more or less developed. In the northern part of West Greenland glabrous forms of *D. daurica* do not seem to be rare. At Tartusak Hus in the Peninsula of Svartenhuk and at Nagliak in Ubekjendt Eiland such glabrous specimens were collected by Dr. M. P. Porsild in 1929.

I have not seen the type of *D. glabella* Pursh which is derived from Arctic America, but it would not surprise me if this plant were identical with a glabrous form of *D. daurica*.

The specimens of *D. daurica* which occur in the North of Scandinavia seem to belong to a pure race, which is also identical with the type plant in Herb. De Candolle. These specimens are devoid of cilia on some of the cauline leaves (f. *typica*). But in the Greenland form of *D. daurica* specimens are found in which (1) all the leaves have a mere stellulate pubescence (f. *typica*) and (2) some of the cauline leaves are more or less ciliated (f. *occidentalis*). This phenomenon should perhaps be regarded as a modification whithin the species but may conceivably be due to some infection from another species. In my recent examinations of *D. daurica* in the Herbaria of Copenhagen, Oslo and Stockholm I have found that hybrids between *D. daurica* and *D. cinerea* or *D. groenlandica* on the one hand, and between *D. daurica* and *D. rupestris* on the other are less rare than I hitherto had supposed. The characteristic feature of the hybrid *D. cinerea* × *daurica* is that the pubescence of the pods is less dense than in *D. cinerea* or that only a few hairs are found on the margin of their valves. Its pedicels often have simple hairs and its sepals have no stellulate ones. The flowers moreover are larger than in *D. cinerea*. In the herbaria such specimens are sometimes labelled »*D. hirta* f. *dovrensis*» which indeed is only natural, seeing that var. *dovrensis* in all probability is an intermediate form between *D. daurica* and *D. groenlandica* (or *D. cinerea*). The »*D. hirta*» var. *hebecarpa* from King Oscar's Harbour (= Tasiusak), described by A. Berlin, is probably likewise identical with this hybrid. The vegetatitive parts of the plant were luxuriant, there being no less than 217 inflorescences, but it was nevertheless fertile. As far as I can remember, I have not seen this specimen in any herbarium.

In hybrids of *D. daurica* it is some times very difficult to distinguish whether the other parent plant is *D. cinerea* (or *D. groenlandica*) or *D. rupestris*, as the commonest form of *D. rupestris* in Greenland is a hebecarp one. The haired pods may thus have been inherited either from *D. rupestris* or from *D. cinerea*. But in specimens where the r a d i c a l leaves are ciliated the other parent plant is in most cases *D. rupestris*. A form of this kind was collected by N. Hartz in 1890 at Fiskenæsset. It should be noted that *D. incana*, a species which likewise has a heterotrichous

pubescence, is also found at the last-mentioned place. I consider, however, that this form from Fiskenæsset must be determined as *D. daurica* × *rupestris* (or f. *rupestriformis*). Hybrids of *D. incana* often have a stiff and erect stalk which was not the case with this specimen. In East Greenland *D. daurica* f. *rupestriformis* does not seem to be rare. It also occurs in Svalbard and in Nova Zembla. It might be objected that *D. rupestris* does not occur in Nova Zembla. This form has indeed not been recorded from this area. For several years I have, however, cultivated a form, apparently belonging to the group of *D. rupestris,* collected by B. Lynge in 1923 on that Island. Quite apart from the heterotrichous pubescence, the small flowers and other characteristics, this plant in fact proved to be a form of *D. rupestris.* This was shown by the facility with which it was cultivated and its endurance of dry weather. It flourished and fruited at least three times in the course of a summer in Hortus Bergianus near Stockholm. (The high-arctic species *D. oblongata* R. Br. and *D. subcapitata* Simmons on the other hand can be cultivated only with great difficulty. Hitherto they have not survived the first winter.) The plant from East Greenland and Clavering Island, which Buchenau and Focke described as *D. arctica,* but in which the stellulate hairs were often replaced by simple and furcate ones, was possibly *D. daurica* f. *rupestriformis.* Schulz believed it to be a form of »*D. norvegica*» (= *D. rupestris*) but the luxuriant growth, the glabrous pods and the wide dispersion of f. *rupestriformis* in East Greenland seem to indicate that it actually was this form.

D. daurica f. *brachycarpa* was found at Narsak near Nord-Pröven. In 1923, before my visit to Greenland, I found in the herbarium of Copenhagen specimens from that locality which had a somewhat condensed raceme and shorter pods with a longer style than the typical *D. daurica.* When in August 1923 I spent a day in Pröven, I seized the opportunity of visiting Narsak in order to collect this new form. The spot where the specimens had been collected was described with such precision that it was easily found. I in fact discovered such specimens though the styles seemed to be somewhat shorter than in the Copenhagen ones. (The styles of *Drabae* vary much in length.) I consider this form to be a local one, the short pods and the condensed raceme being presumatly due to the violent gales which prevail there. Many

shells and sea-urchins were found in the grass some metres above sea-level, being cast up by the storm. These special characters, viz. the short pods and the condensed racemes, were much modified under culture. This was also the case with the short raceme of f. *condensata* (Lange) which I had found at Umanak. I must mention, however, that my study of these two forms has not been pursued beyond the second year. It is possible that after some years more they would have changed entirely into the typical *D. daurica*.

D. daurica var. *lutescens* was found by me at Atanikerdluk on the Mainland on the east coast of the Vaigat. The hybrid *D. alpina* × *daurica* had been found there by Th. M. Fries in 1871, and at the first sight one might have been inclined to suppose that var. *lutescens* likewise was a hybrid because of its yellow colour. But in this variety there were no other indications that the plant was a hybrid. Even the cauline leaves had a mere pubescence of stellulate hairs. This form thus seems to be merely a variety in colour. The sepals in the second generation were of a bluish-violet colour when young, but turned later on dark green, whereas the sepals of the typical *D. daurica* are of a light green colour. Var. *lutescens* was found by the American botanist Mr. C. O. Erlanson in 1928 at the same place where I had found it in 1923. This form has been cytologically examined by Dr. O. Heilborn. It has the same chromosome number as the typical *D. daurica,* viz. 32 haploides chromosomes. This is also the chromosome number of *D. daurica* f. *condensata* (Lange). Cf. Hereditas IX, 1927, p. 62 and 63.

The hybrid *D. alpina* × *daurica* has been found in Greenland not only as above mentioned by Th. M. Fries but also by Mr. A. E. Porsild. The specimens in Herb. Cop. from Disko, Kvanne-soit 69° 35′ n. lat., and Isunguak 69° 44′ n. lat. as likewise those from Ikorfat 70° 47′ n. lat. were all collected by him. It also occurs in Scandinavia and on the arctic coasts of Russia and Sibiria.

This hybrid, or at least a certain form of it, seems to be identical with *D. glacialis* Adams (non Hook.). All the specimens of it in Herb. Stock. have been labelled *D. glacialis* by the Russian botanist Dr. A. Tolmatchew, even those of which the leaves are ciliated like in *D. alpina*. *D. glacialis* is in fact described by Adams as having a pubescence of mere stellulate hairs. One speci-

men of *D. alpina* × *daurica* from Norway, which I showed to Professor Pohle in 1925, was determined by him as *D. glacialis*. In Drabae Asiaticae p. 120 Pohle also mentions Kongsvold in Norway as a locality for *D. glacialis*. Like other hybrids between two species with a different pubescence, this hybrid varies in pubescence. The specimen from Dovre, which was determined by Professor Pohle, had only stellulate hairs as *D. daurica*, but the still remaining petals were like those of *D. alpina* of a deep yellow colour. In many cases the colour is intermediate or sulphureous. Sometimes a cauline leaf is found on the lower part of the stem, sometimes a bracteal leaf under the lowest pedicel. Reference should moreover be made to the diagnosis of *D. glacialis* by Pohle l. c. which comprises every form of the hybrid *D. alpina* × *daurica*.

The diagnosis of Adams' *Drabae* are very little known, as the publication where they are found are very rare and not accessible to most botanists. I shall here reproduce the diagnosis of *D. glacialis* (and, when I come to deal with *D. alpina*, *D. oblongata* and *D. nivalis*, I will take opportunity to quote diagnosis of species related to them).

Draba glacialis Adams.

»Tota planta hispida pilis stellatis. Caulis caespitoso-repens hinc inde fibras radicales emittens, unde exeunt. Scapi spithamaei simplicimi subnudi, basi foliis paucis (1—3) instructi, e basi parum adscendente erecti striati.

Folia radicalia (potius caulina) numerosa oblongo-lanceolata plana, integerrima, acuta, utrinque hispida, uncialia.

Racemus simplex terminalis corymbosus; pedicellis silicula ovata, glabra longioribus filiformibus patulis. Calycis foliola obovato-oblonga obtusa pilosa viridia, margine parum colorata.

Corolla magna sulphurea, petalis calyce plus duplo longioribus obovatis, subemarginatis.

Stamina majora longitudine germinis. Antherae luteae.

Pistillum vix caylicis longitudene glabrum. Ovarium ovatum. Stigma subcapitata.

Locus. Habitat ad littora maris glacialis in promontoria Bykofskoy Mys dictu, invenitur etiam circa pagum Kumácksurka ad ripas Lenae, 57 milliaria ab urbe Schigansk versus septemtrionem.

Observ. Differt a *Dr. repente* Marsch et *Dr. Gmelini* nobis, quibus proxime accedit: a) defectu stolonum, scapis firmioribus magis erectis; b) majore hispiditate foliorum, scapi, imprimis pedicellorum, qui breviores sunt, pilis stellatis nec simplicibus. c) petalis sulphureis nec sature luteis (aureis); d) siliculis magis ovatis, stylo breviore, stigmate vix capitato.» (Descriptones Plantarum minus cognitarum Siberiae, praesertim orientalis, quas in itinere Ann. 1805 et 1806 observavit M. F. Adams. Memoires des naturalistes de Moscou. V (1817) p. 106.)

It is a peculiar fact that no specimen of *D. daurica* from regions north of Thule c. 76° 35′ n. lat. in Greenland is to be found in the herbaria. Neither is there, as far as I recollect, any forms of *D. daurica* amongst the many *Draba* in Herb. Oslo which were collected by H. G. Simmons in 1898 and 1900 in Ellesmereland. Lange indeed mentions that »*D. hirta*» was found at Polaris Bay 81° 35′ n. lat. by Hart, but if this plant actually grew there, it seems very strange that no subsequent investigator should have discovered it and that the botanists who have explored the northernmost regions of Greenland, have overlooked *D. daurica* whilst they have collected *D. cinerea* and *D. groenlandica*. A possible explanation is that Hart used the term »*D. hirta*» in another sense than Lange himself (the *D. hirta* of Lange is *D. daurica* and its hybrids, not *D. rupestris*) or applied it on another *Draba*, e. g. »*D. arctica*» J. Vahl (= *D. cinerea* Adams). Lange also mentions that *D. rupestris* was found by Hart at Polaris Bay.

In the Copenhagen Herbarium there is a specimen of *D. daurica* »e Franklini Expeditione. Hooker.», which was originally in Hornemanns herbarium. And to judge from a raceme with seed from Liverpool Bay, which I have received from Mr. A. E. Porsild, *D. daurica* is found there. It seems thus that *D. daurica* actually occurs in this region of Arctic America. This plant is moreover found in Svalbard, Nova Zembla and on the arctic coast of Russia and West Sibiria. It might be argued therefore, that the severe climate of North Greenland should not prevent its occurrence there. The explanation may be this: In the above-mentioned areas, Arctic America, Svalbard, Arctic Russia and Sibiria, there are many deep fjords which afford sheltered spots, whilst the shores of North Greenland are more exposed to the polar winds. H. U. Sverdrup has collected a specimen of *D. cinerea* from Ayon Island 69° 52′

n. lat., but *D. daurica* is neither found from this station (Herb. Oslo). Dr. M. P. Porsild, who is certainly the greatest living authority on the ecological conditions of Greenland plants, tells me in a recent letter that it does not surprise him that *D. daurica* has a more southern dispersion than *D. cinerea*. Even in the northern part of Disko, in Nugsuak Peninsula etc. there is a great difference between their prevalence: *D. daurica* grows chiefly on sheltered spots facing the South, whereas *D. cinerea* is found in places where the soil is more barren and which are exposed to the winds. Thus for Porsild. In my opinion *D. daurica* is not addicted to a substrate of limestone, at least not in the same degree as seems to be the case with *D. cinerea* and *D. groenlandica*. *D. daurica* in fact occurs at many stations where the two other species are missing.

D. daurica seems to have its area of dispersion between 76° 35′ and 63° 5′ n. lat. in West Greenland. In East Greenland it is found between 76° 49′ and 65° 35′ n. lat.

Area of distrubution: Arctic America, Greenland, Ireland, Svalbard, Northern Scandinavia and Finland, Nova Zembla, Arctic Russia and Sibiria, Alatau, Altai, Mongolia, Dahuria, Northern China and Turkestan.

Specimens of *D. daurica* are also found in Central Europe at some stations in the Alps of France, Switzerland and Austria. I hope to be able to substantiate this statement in a subsequent paper.

Stations for *D. daurica* in West Greenland.

Thule »Det höje Land paa Vejen till Uvdle» c. 76° 35′ n. lat. Thorild Wulf 1917 (Herb. High School Stock.).

Umanap Timilia 74° 5′ n. lat. Ryder's Expedition 1887 (Herb. Cop.).

Kekertak 73° 43′ n. lat. Ryder's Expedition 1886 (Herb. Cop.); J. A. Björling 1891 (Herb. Stock.).

Tarsiussak 73° 23′ n. lat. Thorild Wulf 1916 (Herb. Cop.) (f. *brachycarpa*).

Manitsok, Isfjord of Upernivik 72° 56′ n. lat. J. A. Björling 1891 (Herb. High School Stock.).

Upernivik c. 72° 47′ n. lat. J. Vahl 1839 (Herb. Cop.); ipse 1923 (f. *condensata* (Lange)).

Interior of Kangerdluarssuk Fjord 72° 38′ n. lat. Ryder's Expedition 1887 (Herb. Cop.).

Parotak in Laksefjord c. 72° 32′ n. lat. Ryder's Expedition 1886 (Herb. Cop.).

Laksefjord A. Lundager 1911 (Herb. Cop.).

Interior of Laksefjord c. 72° 30′ n. lat. M. P. & R. T. Porsild 1911 (Herb. Cop.).
Interior of Amitsuarsuk Fjord c. 72° 23′ n. lat. M. P. & R. T. Porsild 1911 (Herb. Cop.).
North Pröven 72° 23′ n. lat. J. Vahl 1834 (Herb. Cop.).
Narsak near Pröven c. 72° 23′ n. lat. ipse 1923 (f. *brachycarpa*).
Peninsula of Svartenhuk, Umivik 71° 38′ n. lat.
Kekartarssuak Island, Nugatsiak 71° 38′ n. lat. M. P. & R. T. Porsild 1929.
Peninsula of Svartenhuk, Manitsorkut 71° 30′ n. lat. M. P. & R. T. Porsild 1929.
Peninsula of Svartenhuk, Tartussak Hus 71° 22′ n. lat. M. P. & R. T. Porsild 1929.
Ubekendt Ejland, Igdlorssuit 71° 14′ n. lat. M. P. & R. T. Porsild 1929.
Peninsula of Nugssuak, Niakornat c. 70° 49′ n. lat. J. Vahl 1834 (Herb. Cop.).
Peninsula of Nugssuak. Ikorfat c. 70° 46′ n. lat. Sören Hansen 1888 (Herb. Cop.).
Peninsula of Nugssuak Kaerssuarssuk c. 70° 45′ n. lat. ipse 1923; M. P. & R. T. Porsild 1929.
Umanak 70° 40′ n. lat. ipse 1923 (f. *condensata*); M. P. & R. T. Porsild 1929 (eadem f.).
Ikerasak »Gebiet des Umanakfjords» c. 70° 30′ n. lat. Vanhöffen 1893 (Herb. Cop.).
Karajak Nunatak, »Gebiet des Umanakfjords» c. 70° 23′ n. lat. Vanhöffen 1893 (Herb. Cop.).
Auinaitsunguak 70° 22′ n. lat. sec. M. P. Porsild 1925.
Kekertak »Gebiet des Umanakfjords» c. 70° 21′ n. lat. Vanhöffen 1893 (Herb. Cop.).
Peninsula of Nugssuak, Ata (= Atane) c. 70° 18′ n. lat. ipse 1923.
»One mile south of Ata» c. 70° 17′ n. lat. C. O. Erlanson 1928.
Peninsula of Nugssuak, Kugssinerssuak c. 70° 17′ n. lat. M. P. & R. T. Porsild 1929.
Disko, Valley east of Iglorpait c. 70° 14′ n. lat. M. P. & R. T. Porsild 1902 (Herb. Cop.).
Disko, Assuk c. 70° 11′ n. lat. M. P. & R. T. Porsild 1929.
Peninsula of Nugssuak, Kingigtok c. 70° 8′ n. lat. N. Hartz 1890 (Herb. Cop.).
Peninsula of Nugssuak, Atanikerdluk c. 70° 2′ n. lat. Th. M. Fries 1871 (Herb. Cop., Herb. Oslo, Herb. Stock.); ipse 1923 cum var. *lutescens*; C. O. Erlanson eadem var. 1928.
Disko, Kutdlisat c. 70° 1′ n. lat. N. Hartz 1900 (Herb. Cop.) (f. *condensata*); ipse 1923.
Peninsula of Nugssuak, Sarkak (= »Sakkene») 70° n. lat. J. Vahl 1835 (Herb. Cop.).
Disko, Nordfjorden c. 69° 57′ n. lat. Th. M. Fries 1871 (Herb. Cop.).
Disko, interior of Nordfjorden, northern shore c. 69° 56′ n. lat. M. P. Porsild 1902 (Herb. Cop.).
Disko, Unartuarssuk c. 69° 55′ n. lat. M. P. Porsild 1902 (Herb. Cop.).
Disko, Narsak 69° 54′ n. lat. Th. M. Fries 1871 (Herb. Stock.) (f. *condensata*); N. Hartz 1890 (Herb. Cop.) (eadem f.).
Disko, Ujaragsugssuk c. 69° 52′ n. lat. ipse 1923.

Ritenbenk c. 69° 44′ n. lat. J. Vahl 1835 (Herb. Cop.); G. Sydow 1883 (Herb. Cop.); S. Berggren 1870 (Herb. Stock.); N. Hartz 1890 (Herb. Stock.).

Disko, north coast of Mudderbugten c. 69° 44′ n. lat. M. P. Porsild 1898 (Herb. Stock.).

Disko, Kugak of Mudderbugten c. 69° 44′ n. lat. M. P. Porsild 1902 (Herb. Cop.).

Disko, north coast of Mellemfjorden c. 69° 44′ n. lat. M. P. Porsild 1902 (Herb. Cop.).

Disko, Mellemfjorden c. 69° 43′ n. lat. Th. M. Fries 1871 (Herb. Oslo).

Disko, Mount Nakerdlok at the Disko Fjord c. 69° 37′ n. lat. M. P. Porsild 1902 (Herb. Cop.).

Disko, Sydostbugten c. 69° 35′ n. lat. N. Hartz 1890 (Herb. Cop.).

Pakitsokfjord, Jakobshavn 69° 28′ n. lat. J. Vahl 1833; M. P. Porsild 1915 (Herb. Cop.).

Disko, Iglutsiak, Sydkysten c. 69° 20′ n. lat. M. P. Porsild 1902 (Herb. Cop.).

Disko, Kuanit near Godhavn c. 69° 16′ n. lat. S. Berggren 1870 (Herb. Stock.).

Disko, Godhavn 69° 15′ n. lat. S. Berggren 1870 (Herb. Stock.); A. Berlin 1883 (Herb. Stock.); Th. Holm 1886 (Herb. Stock.); H. G. Simmons 1898 (Herb. Oslo); G. Kleist 1904 (Herb. Stock.); M. Rickli 1908 (Herb. Stock.); ipse 1923.

Jacobshavn 69° 13′ n. lat. J. Vahl 1832 (f. *condensata*) (Herb. Cop.); Pfaff »ex Herb. Hornemann» (Herb. Stock.).

Natdluarssuk c. 69 13′ n. lat. E. Warming & Th. Holm 1884 (Herb. Cop.).

Semermuit 69° 10′ n. lat. S. Berggren 1870.

Claushavn 60° 5′ n. lat. S. Berggren 1883 (Herb. Stock.); Ryder's Expedition 1889 (Herb. Cop.).

Kunguak, south of Jacobshavn Isfjord c. 69° 3′ n. lat. M. C. Egnell 1902 (Herb. Cop.).

Christianshaab 68° 49′ n. lat. J. Vahl 1835 (Herb. Cop.); E. Warming & Th. Holm 1884 (Herb. Cop.).

Island of Manetsok 68° 47′ n. lat. A. Berlin 1883; 68° 45′ n. lat. J. A. Björling 1891 (Herb. Stock., Herb. High School Stock.).

Egedesminde 68° 42′ n. lat. A. Berlin 1883 (Herb. Oslo); N. Hartz 1890 (Herb. Cop.); H. G. Simmons 1898 (Herb. Oslo).

Ikamiut 68° 37′ n. lat. A. Berlin 1883 (Herb. Stock.).

Kisengiartak c. 68° 25′ n. lat. A. Berlin 1883 (Herb. Oslo, Herb. Stock.).

Itiflak, north shore of Tassiussarssuak Fjord c. 68° 25′ n. lat. A. Berlin 1883.

Kangaitsiak on the north shore of Aulatsivik Fjord c. 68° 21′ n. lat. S. Berggren & A. Berlin 1883 (Herb. Stock.).

Sofias Harbour, interior of Aulatsivik Fjord c. 68° 21′ n. lat. S. Berggren & A. Berlin 1883. (Herb. Stock.); M. P. Porsild 1924.

Island in Aulatsivik Fjord c. 68° 20′ n. lat. S. Berggren 1883.

North Ström Fjord at the Inland ice 67° 32′ n. lat. A. Kornerup 1875 (Herb. Cop.).

Lake of Tatsip åta, Holsteinborg c. 67° 20′ n. lat. E. Warming & Th. Holm 1884.

Kororsuak, interior of Isortok Fjord 67° 15′ n. lat. A. Kornerup 1879 (Herb. Stock.).
Akuliaserssuk, Isortok Fjord c. 67° 10′ n. lat. A. Kornerup 1879 (Herb. Cop.).
Reindeer ranges, east of the Isortok Fjord 1.200 feet s. m. A. Kornerup 1879 (Herb. Oslo).
Itivnek, Holsteinborg c. 66° 57′ n. lat. E. Warming & Th. Holm 1884 (Herb. Oslo, Herb. High School Stock.).
Prestefjeldet near Holsteinborg 66° 55′ n. lat. E. Warming & Th. Holm 1884 (Herb. Cop.).
»Prope coloniam Holsteinborg» c. 66° 55′ n. lat. J. Vahl 1832 (Herb. Cop.).
Sarfanguak, Holsteinborg c. 66° 53′ n. lat. E. Warming & Th. Holm 1884 (Herb. Cop.).
Ikertok (= »sinus Ikkatok»), Holsteinborg c. 66° 50′ n. lat. J. Vahl 1832 (Herb. Cop.).
Head of Söndre Ström Fjord 66° 50′ n. lat. J. A. Jensen 1884; C. O. Erlanson 1927 (Herb. Cop.).
Ikertok Fjord, Holsteinborg c. 66° 45′ n. lat. A. Kornerup 1879 (Herb. Cop.;) E. Warming & Th. Holm 1884 (Herb. Cop.).
Godthaab, interior of Ameralik Fjord c. 64° 12′ n. lat. J. N. Nygaard 1907 (Herb. Cop.)
Godthaab, Ameralik Fjord, Ekaluit, c. 64° 2′ n. lat. J. Vahl 1832 (Herb. Cop.).
Fiskenæsset c. 63° 5′ n. lat. N. Hartz 1890 (Herb. Cop.) (var. *rupestriformis*).

Stations in East Greenland.

Little Sneness c. 76° 49′ n. lat. A. Lundager 1908 (Herb. Cop.).
Muskox Fjord c. 73° 40′ n. lat. K. A. G. Gredin (Herb. Stock.); J. Vaage 1929, det. J. Lid (Herb. Oslo).
Mackenzie Bay c. 73° 35′ n. lat. K. A. G. Gredin 1900.
»Myggbukta» 73° 30′ n. lat. J. Vagge 1929, det. J. Lid (Herb. Oslo.)
»Reinbukta» 73° 23′ n. lat. J. Vaage 1929, det. J. Lid (Herb. Oslo).
Franz Joseph Fjord c. 73° 23′ n. lat. Zweite Deutsche Nordpolsexpedition 1867—70 (Herb. Stock.); K. A. G. Gredin 1900 (Herb. Stock.).
Kjerulfs Fjord, interior of Franz Joseph Fjord c. 73° 20′ n. lat. P. A. Dusén 1899 (Herb. Stock.); J. Vaage 1929, det. J. Lid (Herb. Oslo).
»Blomsterkysten» on Ymer Island 73° 20′ n. lat. J. Vaage 1929, det. J. Lid (Herb. Oslo).
Dusénfjorden c. 73° 20′ n. lat. J. Vaage 1929, det. J. Lid (Herb. Oslo).
Cape Humbolt on Ymer Island c. 73° 14′ n. lat. J. Vaage 1929, det. J. Lid (Herb. Oslo.)
»Husbukta» on Geographical Society Island 72° 50′ n. lat. J. Vaage 1929, det. J. Lid (Herb. Oslo).
Veganess on Trail Island c. 72° 50′ n. lat. J. Vaage 1929, det. J. Lid (Herb. Oslo).
Scoresby Sound, Nordvestfjorden c. 71° 35′ n. lat. A. Pedersen 1925 (Herb. Cop.).
Jamesons Land c. 70° 40′ n. lat. A. Pedersen 1929 (Herb. Cop.).
Scoresby Sound, Rosenvinge Bay, c. 70° 30′ n. lat. A. Pedersen 1925 (Herb. Cop.).

Danmarks Ö c. 70° 30′ n. lat. N. Hartz 1882 (Herb. Cop.).
Cape Stewart c. 70° 30′ n. lat. A. Pedersen 1925 (Herb. Cop.).
Cape Dalton 69° 20′ n. lat. C. Kruuse 1900 (Herb. Cop., Herb. Oslo).

From East Greenland only stations for typical specimens of *D. daurica* are given.

Hybrids of *D. daurica* are found at the following localities in West Greenland.

Kekartarssuak Island 71° 31′ n. lat. M. P. & R. T. Porsild 1929. Pods hairy but pedicels with long simple hairs. *D. daurica* × *cinerea* vel *groenlandica*.

Peninsula of Svartenhuk, Tartussak Hus 71° 22′ n. lat. M. P. & R. T. Porsild 1929. Pods somewhat hairy, some of the radical leaves with a dense grayish pubescence of stellulate hairs, other glabrous but ciliated by long simple hairs almost to the apex. *D. daurica* × *groenlandica* var. *arctogena*.

Upernivik Island 71° 10′ n. lat. M. P. & R. T. Porsild 1929. Pods somewhat hairy, a pubescence (on the leaves) of more simple hairs than in *D. cinerea* and *D. daurica*. *D. daurica* × *groenlandica*.

Peninsula of Nugssuak, Kaerssuarssuk c. 70° 45′ n. lat. M. P. & R. T. Porsild 1929. A form with somewhat haired pods. *D. cinerea* × *daurica*?

Peninsula of Nugssuak, The big Valley 70° 39′ — 70° 27′ n. lat. M. P. Porsild 1902 (Herb. Cop.). *D. cinerea* × *daurica*?

Peninsula of Nugssuak, Ata (= Atane) c. 70° 18′ n. lat. ipse 1923. A high plant with 131 inflorescences and haired pods but abortive seed. *D. daurica* × *groenlandica* (vel *cinerea*).

Peninsula of Nugssuak Atanikerdluk c. 70° 2′ n. lat. Th. M. Fries 1871 (Herb. Oslo). *D. cinerea* ad *dauricam*?

Disko, Narsak 69° 54′ n. lat. Th. M. Fries 1871 (Herb. Cop.). A condensated form with some simple hairs on the blade of some leaves. (Collected together with a typical *D. daurica* f. *condensata*.) *D. daurica* × *rupestris*.

Disko on Basalt »*D. hirta* var. *dovrensis*» E. Warming & Th. Holm 1884 (Herb. Stock.) is probably *D. daurica* × *groenlandica*.

Disko, Kuanit 69° 16′ n. lat. R. T. Porsild 1929. *D. daurica* × *groenlandica*.

Disko, Godhavn 69° 15′ n. lat. G. Kleist 1904 (Herb. Oslo); ipse 1923. High plants with some few simple hairs on the pods. *D. daurica* × *rupestris* vel *groenlandica*. H. G. Simmons has collected in 1898 (Herb. Oslo) at Godhavn a form with the large flowers of *D. daurica* but the pubescence of *D. rupestris*. *D. daurica* × *rupestris*.

Jakobshavn 69° 13′ n. lat. E. Warming & Th. Holm 1884 (Herb. Cop.) A condensated form ressembling *D. daurica* f. *condensata* as to habit but with some simple hairs on some of its blades. *D. daurica* × *rupestris*.

Semermuit 68″ 10′ n. lat. S. Berggren 1870 (Herb. Stock.). From this station two different hybrid forms were collected, the one more related to *D. daurica*, the ohter to *D. cinerea*. (This latter form cannot be distinguished from *D. magellanica* var. *dovrensis*, which — with all probability — is of a hybridous origin.)

Kororsuak, interior of Isortok Fjord 67° 15′ n. lat. A. Kornerup 1879 (Herb. Oslo). *D. cinerea* × *daurica*?

Reindeer ranges east of Isortok Fjord 1.200 feet s. m. A. Kornerup 1879 (Herb. Stock.). *D. cinerea* × *daurica*?

PLATE III.

List of illustrations.

1. *D. daurica* f. *brachycarpa* from Narsak near Nord-Pröven, collected in 1923.
2. *D. daurica* f. *condensata* (Lange) from Umanak (1923).
3, 4. Small specimens of *D. daurica* from Mackenzie Bay, East Greenland, collected by C. A. G. Gredin in 1900.
5. A slender form of *D. daurica* from Atanikerdluk, West Greenland (1923).
6. *D. daurica* var. *lutescens* found in 1923 at Atanikerdluk.
7. *D. groenlandica* var. *arctogena* from Godhavn, Disko (1923).
8. *D. cinerea* collected by Dr. M. P. Porsild in 1929 at Magdlak, Ignerit Fjord, West Greenland.
9. Stem of a specimen of *D. daurica* from Godhavn with its large flowers.
10. *D. groenlandica* from Godhavn collected in 1923.

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ETT BIDRAG TILL SPETSBERGSÖARNAS LAVFLORA.

av

GUST. O. A:N MALME.

I den polarexpedition, som under professor A. G. Nathorsts ledning utsändes från Sverige 1898, deltogo som botanister Gunnar Andersson och Henrik Hesselman. Ingendera hade förut något mera ingående sysslat med kryptogamer, och det var då helt naturligt, att de under resan skulle företrädesvis ägna uppmärksamhet åt fanerogamvegetationen. De hemförde dock även (förutom mossor) en liten samling lavar, nästan uteslutande busk- och bladlavar. Något i systematiskt hänseende anmärkningsvärt innehåller samlingen icke, men då den härstammar från trakter, som voro lichenologiskt fullständigt outforskade — Svenska förlandet, Kung Karls land, Vita ön (eller Giles land) och Karl XII:s ö — synes den dock förtjäna ett omnämnande. Största intresset anknyter sig till de arter, som hemförts från de båda sistnämnda öarna, då de kunna betraktas som lavvegetationens längst framskjutna utposter i denna del av polarområdet. Vita ön är så fullständigt betäckt av is och snö, att några fanerogamer, såvitt bekant är, icke förmått slå sig ner där, och mossfloran räknar endast 10 arter, nio bladmossor och en levermossa. De hemförda lavarna uppgå till 13 arter, av vilka dock två äro så svagt utbildade, att de ej kunnat säkert bestämmas. Mycket antagligt är ju, att en lichenolog skulle kunna anträffa åtskilligt flera, särskilt om han hade tillfälle att ägna något mera än en eller annan timme åt insamlingen, men i alla händelser är nog fattigdomen det mest framträdande draget även i lavvegetationen. De hemförda exemplaren bära också en omisskännlig prägel av att ha vuxit under extremt ogynnsamma förhållanden. Endast de båda *Gyrophora*-arterna (samt skorplavarna) äro för-

sedda med apothecier och det mycket sparsamt. Något gynnsammare synas förhållandena gestalta sig på Karl XII:s ö. En bild av ön visar också, att där finnas ej så obetydliga partier, som icke beständigt täckas av snö och is. De därifrån hemförda exemplaren av *Gyrophora reticulata* och *G. arctica,* särskilt den förra, äro kraftigt utvecklade. Med kännedom om dessa lavars långsamma tillväxt, även där en mycket längre vegetationsperiod står till deras förfogande, får man antaga, att de uppnått en verkligen vördnadsvärd ålder.

Beträffande expeditionens förlopp hänvisas till A. G. Nathorst, Om 1898 års svenska polarexpedition (Ymer 1898, sid. 321—348), och H. W. Arnell, Beiträge zur Moosflora der Spitzbergischen Inselgruppe (Sv. Vet.-Akad. Översikt. 57 [1900], sid. 99—130).

Kung Karls land.

Sphaerophorus globosus (Huds.) Wainio, sterilis.
Psoroma hypnorum (Dicks.) Hoffm., cum apoth.
Solorina crocea (L.) Ach., sterilis.
Nephroma expallidum Nyl., sterilis.
Peltigera aphthosa (L.) Hoffm., sterilis.
P. canina (L.) Hoffm. var. *rufescens* (Neck.) Mudd, cum apoth.
Stereocaulon alpinum Laur., sterile.
Gyrophora hyperborea Ach., cum apoth.
G. proboscidea (L.) Ach., cum apoth.
Parmelia pubescens (L.) Wainio, sterilis.
P. omphalodes (L.) Ach., sterilis.
Cetraria Delisei (Bory) Th. Fr., sterilis.
Alectoria nigricans (Ach.) Nyl., sterilis.
Usnea sulphurea (Koen.) Th. Fr., sterilis.
Thamnolia vermicularis (Sw.) Ach., sterilis.
Adest praeterea speciminulum *Cladoniae* sp.

Svenska förlandet.

Peltigera malacea (Ach.) Fr., specimen miserrimum incertum.
Stereocaulon denudatum Floerke var. *pulvinatum* (Schaer.) Flot., sterile.
Cetraria islandica (L.) Ach. ad **crispam* Ach. accedens, sterilis.
C. Delisei (Bory) Th. Fr., sterilis.

Vita ön (Giles land).

Sphaerophorus globosus (Huds.) Wainio f. *congesta* (Lamy), sterilis.
Lecidea tornoënsis Nyl., supra muscos destructos.

Stereocaulon alpinum Laur., specimen congestum, miserrimum, incertum.
Gyrophora erosa (Web.) Ach., specimina perparva; cortex hypochlor. calc. non reagens.
G. hyperborea Ach., cum apoth.
Lecanora verrucosa (Ach.) Laur., cum apoth.
Parmelia intestiniformis (Vill.) Ach., specimen miserrimum, sterile.
P. pubescens (L.) Wainio, sterilis.
Cetraria nivalis (L.) Ach., sterilis.
C. Delisei (Bory) Th. Fr., sterilis.
Rinodina turfacea (Wahlenb.) Th. Fr., cum apoth.
Praeterea adsunt vestigia *Ochrolechiae* sp. et *Cetrariae aculeatae* (?).

Karl XII:s ö.

Sphaerophorus globosus (Huds.) Wainio f. *congesta* (Lamy), sterilis.
Gyrophora reticulata (Schaer.) Th. Fr. f. *discolor* (Th. Fr.), sterilis.
G. arctica Ach., cum apoth.
Cetraria Delisei (Bory) Th. Fr., sterilis.

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DISCOMYCETEN URNULA CRATERIUM (SCHW.) FR. — EN FÖR SVERIGE NY STORSVAMP.

AV

CARL TH. MÖRNER.

Med nöje går jag att fullfölja av förste meddelaren, rektor Carl Malm (Malmköping), välvilligt lämnat medgivande att i facktidskrift presentera åsyftade, förvisso remarkabla fynd. Enär föremålet icke torde hava avhandlats i inhemsk litteratur sedan tiden för dess systematiska behandling av Elias Fries (i förra hälften av 1800-talet), lämnas här, till en början, en orienterande redogörelse för, vad som i ämnet känt och vittnat är inom litteraturen i övrigt (I), varefter komma att anföras med det svenska fyndet förknippade omständigheter (II).

I.

Att beteckningen »storsvamp» här är på sin plats, därom kan ej tvivel råda. I ett 10-tal av bifogade litteraturförteckningars publikationer förekomma, på olika språk uttryckta, arten avseende epitet, sådana som: »stor», störst», »i ögonen fallande» (se även här nedan sammanställda dimensionssiffrorna!). För övrigt är det ej fråga om någon från närstående arter endast med svårighet urskiljbar art eller om någon systematisk obetydlighet (»småart», varietet el. dyl.), utan fastmera om en svamp av utpräglad egenart, av Schulzer (1887) betecknad som »ebenso auffallende wie merkwürdige Art» och av Boudier (1898) framhållen som »une Pezizacée des plus intéressantes».

Försöksvis gjord inrangering i ett eller annat större släkte har ej utfallit lyckligt. Arten har i så fall kommit att stå som en relativ främling utan önskvärd anknytning till de övriga, vadan kravet å särsläkte — i första hand för artens egen räkning — gjort sig kännbart.

Den allra första beskrivningen och namngivningen (*Peziza Craterium*) lämnar v. Schweinitz (1822) med ledning av material från Nord-Carolina. Fries väljer 1828 nya namnet *Cenangium Craterium*, vilket han emellertid inom kort övergiver, för att (1849) införa ett annat. Av honom kreeras sistnämnda år nya släktet *Urnula*, karakteriserat sålunda:

»Excipulum coriaceum, inflatum, inane, clausum, dein ore rotundo rimos dehiscens. Discus latera inferiora vestiens sporis moniliformi-seriatis intermixtis paraphysibus. Superficiales, byssisedae. Typus: *Peziza Craterium* Schwein.!»

Detta släkte — »singularis hoc genus» (Fries 1851), »the curious genus Urnula Fr.» (Berkeley) — har, även i fortsättningen, tett sig exklusivt: Boudier (1907) räknar (för Europa) med inalles endast 3 arter, Seaver (för U. S. A.) med 2 arter, varvid, i båda fallen, den första arten, *U. Craterium*, utgör en. Frieska namnet, fullständigare utskrivet: *Urnula Craterium* (Schw.) Fr., har senare av sin auktor definitivt vidhållits och blivit, framför andra under tiden tillkomna, accepterat av bl. a. Boudier, en av mykologiens främste och, in i våra dagar, av amerikanska mykologerna Seaver och Bisby.

Synonymer (delvis uppkomna enbart på grund av otillräcklig kännedom om v. Schweinitz-Frieska inläggen) hava uppträtt i avsevärt antal, baserade på ytterligare åtminstone 8 släkt- och 4 artnamn i diverse olikartade kombinationer.

Ehuruväl Boudier bestämt ogillat svampens ifråga hänförande till *Geopyxis*-släktet, har det av Rehm 1896 tillskapade namnet *Geopyxis Craterium* (Schw.) Rehm, vilket även i övrigt väckt föga anklang, kommit till användning så nyligen som år 1920 i den allbekanta, vida spridda svampfloran Rickens Vademecum (varest dock det senare av auktorsnamnen blivit avglömt).

Det enda icke-latinska namn, som mött vid litteraturstudiet, är: »Schwarzer Kelchpilz» (Ricken).

Beskrivning över egenskaper, makro- och mikroskopiskt iakttagbara, finner man flerstädes; från nyare tid bl. a. hos Migula, Ricken och Seaver. Den senares beskrivning, relativt utförlig och mönstergillt avfattad, har följande lydelse.

»*Urnula* Fr. Apothecia opening with a stellate aperture or by a number of transverse slits through the apex, leaving the margin crenate or split into a number of rays, externally tomentose; asci cylindric or subcylindric,

8-spored; spores ellipsoid to fusoid, hyaline or subhyaline; paraphyses very slender, often branched.»

— —

»*Urnula Craterium* (Schw.) Fr. Apothecia at first closed above, finally opening by a starshaped aperture which leaves the margin notched and infolded, externally black or brownish-black and clothed with a dense covering of tomentum, reaching a diameter of 3—4 cm. and a depth of 4—6 cm., the substance tough and leathery; hymenium brownish-black, a little paler than the outside of the apothecium; stem reaching a length of 3—4 cm. and a diameter of 5—8 mm., even or very slightly lacunose near the base, black or brownish-black and attached to the substratum by a dense mass of black mycelium, gradually expanding above into the apothecium; hairs variable in length, thin-walled sparingly septate, flexuous, about 10 µ in diameter and of nearly uniform thickness throughout their entire length; asci cylindric above, tapering below into a long stem-like base, reaching a length of 600 µ and a diameter of 15—17 µ; spores 1-seriate, broad ellipsoid, smooth, hyaline, 12—14 × 25—35 µ; paraphyses filiform, slightly enlarged above, pale-brown.»

Beskrivningen åtföljes av fotografisk avbildning, bl. a. utvisande tuvat växtsätt, vilket förhållande bort, för ordningens skull, angivas även i den beskrivande texten såsom för arten karakteristiskt och framhållet redan i de grundläggande arbetena av v. Schweinitz och av Fries (»subcaespitosa», »gregaria»), senare av t. ex. Rehm och Migula (»gesellig»). Till Seavers översikt av synonymer torde, med hänsyn till europeiska litteraturen, böra läggas: *Peziza lugubris* Kalchbr. (1865).

Några faktorer, utöver de i citerade artbeskrivningen innehållna, komma här att något närmare avhandlas.

Iakttagna växlingar i dimensioner åskådliggöras i bifogade översiktstabell (avseende tiden före Seavers arbete, 1928).

	Makromått (cm)		Mikromått (µ)	
	Svamp (apothecium) in toto	Fot	Sporsäckar (asci)	Sporer
Winter	—— ×2—8	1—5× ——	400—500×14—15	23—33×10—13
Haszlinski	10—12×5—6	————	————	————
Schulzer	————	1—5× ½—1	drygt 500× ——	23—25×10—11
Boudier	—— 7×6	1 ½× ——	500—550×18—20	26—30×13—14 (franskt material)
				34—44×14—18 (amerik. o. ung. material)
Ricken	4—10×1—5	————	————	28—33×10—13
Migula	—— ×2—8	1—5× ½—1	400—500×14—15	28—33×10—13

Utbredning. Förekomst finnes angiven för nedannämnda områden.

I. Amerika.

1. Förenta Staterna: Nord-Carolina och Pennsylvanien (v. Schweinitz 1822 resp. 1834), Ohio (Saccardo), New York till Nord-Dakota, Alabama och Mississippi (Seaver).
2. Canada.
   a. Manitoba: inom sydliga delen (gränsande till Nord-Dakota) 3 lokaler angivna: Victoria Beach, Indian Bay och Manitoba Agricultural College (Bisby).
   b. Berkeley uppgiver: »[Urnula Craterium Fr.] — — — was found in arctic America by Drummond», vilken lakoniska avfattning återgives av Saccardo (sid. 549). Av Hooker lämnade upplysningar göra det sannolikt, att med »arctic America» härovan avses nordliga Canada (medan Alaska och Grönland äro uteslutna). Någon uppgift om närmare lokalisering har förf. icke lyckats uppspåra.

II. Europa.

1. Öst-E.
   a) Ungern (i »förkrigisk» bemärkelse): Wallendorf (Kalchbrenner, Winter 1883); »im Kesmarker grossen Walde», »im Walde bei Eperies», »im Szinyeer [Thale] und im Seberer Thale», »aus dem Unger Comitate» (Haszlinski) — lokaler, belägna i nordliga delen, mestadels nära intill Karpaternas sydsluttningar.
   b) Slavonien: »im Nuštarer Walde», im Retki gaj» (Schulzer 1866), Vincovce (densamme 1887).
   c) Ost-Preussen — varken i första uppgiften (Winter 1881) eller i senare sådana (Rehm, Migula) omnämnes någon särskild lokal.
2. West-E. Frankrike (Bois Lecuyer nära Charleville (Boudier 1898 o. 1905—10) — i sydkanten av Ardennerna, ej långt från belgiska gränsen.

Ifråga om frekvens inom resp. utbredningsområden finnas endast några få antydningar.

Att svampen i de angivna partierna av Förenta Staterna är »freqvens», »vulgaris» eller »sehr weit verbreitet» vitsordas av v. Schweinitz (1822 och 1824) resp. Winter (1883).

I anledning därav, att Haszlinski låtit undfalla sig yttrandet: »Dieser Pilz ist gewiss die auffallendste [Pezizacé] auf ungarischem[1] Gebiete», gör Schulzer (1887) — som redan förut, i samma publikation, framhållit *U. Craterium* som »in Europa seltene[2] Art» — följande kraftiga utsago: »Das Lesen der Beschrei-

[1] Spärrstil vid citerandet.
[2] » i originalet.

bung des Autors weckt unwillkürlich die Vorstellung, dass dieser Pilz häufig vorkomme. Wie gesagt, ist gerade das Gegentheil der Fall![1] Man frage nur Dr. Winter, welcher bei Herausgabe seiner Exsiccata die benöthigte Anzahl davon in Europa nicht zuzammenbringen vermochte, sich daher dieselbe aus Amerika kommen lassen musste. — — — Während meines langen Aufenthaltes in verschiedenen Gegenden Ungarns sah ich ihn [den Pilz] nicht».

Det av Boudier (1898) rapporterade fyndet å Frankrikes mark omfattar ett enda exemplar, och senare har, förf. veterligt, intet nytt försports från denna landsända.

Erforderlig terrängbeskaffenhet angives undantagslöst vara skog (»in silvis» etc.) eller, i varje fall, dock trädbevuxen mark. De enda av förf. funna specialuppgifterna härutinnan äro följande:

»Der Pilz scheint [in Slavonien] nur junge, etwas erhabene Waldungen der Weissbuche [Carpinus betulus] zu lieben» — Schulzer (1887).

Den franska fyndorten beskrives av Boudier (1898) ligga i en skog av äkta kastanje (*Castanea*) och avenbok (*Carpinus*), å sandig och kalkhaltig mark.

Allmänneligen lyda uppgifterna angående substratet på föremål av multnande trä, vanligen i form av nedfallna, i jorden m. el. m. nedsänkta trädgrenar. Av Boudier (1907) nämnes, som alternativ, även multnande [träd]rötter, och Kalchbrenner omtalar ett fynd uti genom insektåverkan uppkomna hålrum i trädstam. Haszlinski omförmäler sig hava sett förekomst »auch auf noch hartem Holze». Hos ett par auktorer (Winter 1881, Saccardo) finner man, ävenledes endast som alternativ, anfört: »ad terram», d. v. s. förekomst direkt å jordskikt, utan iakttagbart träsubstrat.

Men, å förevarande område, gives det jämväl ett par mera specifika uppgifter om substratets härstamning. Schulzer (1866 o. 1887) utpekar avenbok (vilket förhållande ej blivit beaktat av Oudeman). Det förutnämnda ihåliga trädets art angiver Kalchbrenner med orden »veres fenyö» [rent verbalt = röd-barrträd], d. v. s. ungerska benämningen å vanligt lärkträd (*Larix decidua* Mill.), såsom ock riktigt blivit översatt (»*Pinus Larix*») i Hedwigia (1865) och därefter rätt återgivits (»*Larix europaea* DC.») hos Oudeman (sid. 380). Å andra sidan har samma, av Kalchbrenner anförda ungerska namn, oriktigt översatt till »Fichte», influ-

[1] Spärrstil i originalet.

tit hos Winter (1883); ungrarnas reguljära namn för Fichte (vanl. gran, *Picea excelsa* Lk.) är: lúcz fenyō (verbalt = gran-barrträd). När slutligen hos Oudeman (sid. 557) — med hänvisning till samma Kalchbrennerska publikation och till nyssnämnda av Winter — *Pinus silvestris* L., vanlig tall (i ungerskt språk: erdei fenyō (verbalt = skogs-barrträd)) uppföres såsom uti ifrågavarande fall substratbildande, innebär detta oförtydbart en inadvertens. Vid till-

Foto C. Alm

Fig. 1. *Urnula Craterium* (Schw.) Fr. Leg. [illegible] 1930 C. Malm. — Nat. storl.

rättaläggandet av detta kännedom i ungerska språket fordrande spörsmål har prof. Karl. Wiklund välvilligt lämnat sitt bistånd.

Som årstid för svampens uppträdande angives undantagslöst våren (event. den tidigare) i allmänna ordalag (»vere», »primo vere», »in early spring») eller, mera preciserat, fr. o. m. mars (Schulzer 1866 o. 1887, Boudier 1898) t. o. m. maj (förstnämnde auktor), medan Bisby upptager enbart maj.

II.

Den terräng, som utgör svampens enda, hittillsvarande kända svenska och därmed även skandinaviska hemvist, är en liten dälď — mellan de långsmala småsjöarna He-

naren (i N) och Västersjön (i S), Hyltinge s:n i hjärtat av Södermanland — situerad, fågelvägen räknat, 4 km OSO från Malmköping, 2 km NNV från Sparreholms järnvägsstation. Dälden, med approx. N—S-riktning, genomflytes av en friskt porlande å (med sammanlagt 4 m:s fallhöjd på $^1/_2$ km:s sträcka), vilken bildar avlopp för den nordligare sjön; å dess östra sida en brantare, blockförsedd sluttning. Vegetationsbilden är av lövängstyp. Där förekomma bl. a. snår av asp, hassel, hägg, klibbal, skogslind, sälg och try, av örter: gullpudra, kabbeleka, lungört, sippor (blå-, gul-, vit-), svalört, underviol, vårärt, vätteros. Bland här iakttagna svampar må nämnas bombmurkling *Bulgaria globosa* Fr. (i Malmköpingstrakten sedd å ytterligare 3 ställen).

[Till däldens övriga behag kommer, under vår och försommar, talrikt häckande sångfåglar av flerfaldiga slag.]

Från besök $^5/_5$ 1928 i denna idylliska miljö lämnar rektor Malm här citerade sympatiska skildring:

»Det var avslutningen på en skön dag. Hela familjen var ute på exkursion. Mor letade efter Viola mirabilis, som hon älskar och årligen brukar hälsa på; jag rotade efter Lathraea, och ungdomarna voro verksamma strax intill. Så hojtar 9-årige Lars: 'Far, här finns det fina rökpipor!' — och kommer rusande med en i fullt bruk. När jag visade mig intresserad, kom han genast med några till, och innan jag hann bromsa, blev det sex.»

Själva fyndplatsen ligger på däldens östra sida, omkr. 100 m från åns utflöde i Västersjön.

Hela det omhändertagna svampmaterialet, oförtövat sänt till Uppsala med förf. som adressat, överlämnades till fil. kand. Axel Nannfeldt, som redan $^{10}/_5$ s. å. kunde meddela resultatet av sin bestämning: »Svampen heter *Urnula Craterium* (Schw.) Fr. Är allmän i Nordamerika men ytterligt sällsynt i Europa — — —. Alltså ett mycket intressant fynd.» Sända materialet (inrangerat i Bot. instit:s i Uppsala samling) demonstrerades längre fram $^{19}/_2$ 1929 av Nannfeldt inför Bot. sektionen (i samband med en del andra märkligare pezizacéer).

Från efterbesiktning $^{13}/_5$ 1928 å nämnda fyndorten rapporterar Malm, »att det fanns 3 ex. kvar, 2 alldeles på upphällningen och 1 i gott skick, dock vidare upptill än de förut sända».

Medan platsen påföljande året (1929) genomsökts 3 à 4 ggr med negativt resultat, har i år (1930), under Malms exkursioner, anträffats, dels $^{11}/_4$ 8 ex. (bildande samlad grupp), dels $^{24}/_4$ ytter-

ligare 1 ex. (fristående, ett par meter från de andra). Ehuru belägen inom samma däld var detaljplatsen nu en annan (än år 1928), nämligen belägen på västra sidan om ån och omkr. 200 m längre mot N (några få meter från svampgruppen sågs ett vätterosbestånd). Av gruppens exemplar medtogos 5, vilka (i likhet med solo-exemplaret) befordrades till Uppsala. Även detta nya, väl omskötta material hamnade i därvarande bot. instit:s samling, efter det att fotografering och en del mätningar företagits.

Av amanuens Carl Alm utförd, vällyckad fotografisk avbildning av svamparna (apothecierna) in toto finnes här reproducerad (fig. 1).

De 2 största exemplaren företedde 5,0 och 5,2 cm i längd och 2,3 resp. 2,6 cm i bredd; fotens längd var ungefärligen lika med hälften av den totala. Mikroskopisk mätning (av Nannfeldt) utvisade för: sporsäckar 400—440 × 14—16, sporer 26—30 × 11—13, parafyser (i spetsarna) 2 ½ µ. Samtliga måtten, makro- och mikroskopiska, falla inom i litteraturen för arten angivna gränser. Längd av sporsäckarnas sporförande del (pars sporifera), i litteratur ej funnen angiven, bestämdes till: 160—200 µ.

Frågan om substratets beskaffenhet har beaktats, varvid amanuens Gunnar Johansson godhetsfullt ställt sin sakkunskap till förfogande. Undersökningen har gjort det i hög grad sannolikt, att härvidlag hassel varit leverantör.

Med hänsyftning på utseendet (form och färg), ävensom på ovan skildrade lilla episod vid svampens allra första anträffande, bör svenskt namn kunna bildas med »rökpip» som kvalificerande första led, t. ex. rökpipmurkling, rökpipskåling eller kanske — i analogi med blomkål-, igelkott-, oxtungsvamp m. fl. — rätt och slätt: rökpipsvamp (förkortning av »rökpip» till enbart »pip» synes ej vara lämplig, enär sistnämnda epitet redan fått användning i ett svampnamn, pipklubbsvamp [*Clavaria fistulosa* (Holmsk.) Fr.], uti helt annan bemärkelse.

* * *

Denna presentation av *Urnula Craterium* — hos oss nyupptäckt jämnt 100 år efter utgivandet av Elias Fries' Elenchus fungorum — torde vara ägnad att väcka intresse för och underlätta svampens vidare efterforskande inom riket och Skandinavien i övrigt, varvid, som närmast, terräng med hassel- eller avenbokförekomst bör ihågkommas.

Rektor Malms insats för bringande av i naturen överkomna materialet i kontakt med vetenskaplig granskning utgör åter ett gott exempel på, hurusom en intresserad, omtänksam amatör kan göra forskningen god tjänst. För honom, själve upphovsmannen, och för här ovan nämnda Uppsalienses, vilka beredvilligt lämnat sitt bistånd, betygar förf. härmed uppriktig tacksamhet.

LITTERATUR.

Asterisk framför titeln å publikation utvisar, att i denna icke gives upplysning om ifrågavarande svampen i annat hänseende än rent nomenklatoriskt (rörande visst släkte-synonym).

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* —»—, Elenchus fungorum etc. — Del 1. Greifswald 1828, sid. 21.

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Anm. A bandets omslag är (med romerska siffror) angivet »1845». Orättat har sistnämnda årtal återgivits av Winter (1883) och Oudeman (sid. 557).

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SMÄRRE MEDDELANDEN.

Föreningens medlemmar uppmanas, att till denna avdelning insända meddelanden om märkliga växtfynd o. d.

Kärlväxtlokaler i nordöstra Södertörn.

Under sommaren 1929 har jag såsom Botaniska Sällskapets i Stockholm stipendiat gjort ett antal exkursioner genom Tyresö, Dalarö, Österhaninge och Västerhaninge socknar, samtliga belägna strax söder och sydost om Stockholms stad i nordöstra hörnet av Södertörn. Då ifrågavarande område hör till de i floristiskt avseende sämst kända i Stockholmstrakten, kunna nya växtlokaler inom detsamma möjligen vara av allmännare intresse, och meddelas därför härnedan ett utdrag ur mina artlistor. Då några redan förut kända lokaler medtagits, är det antingen för att arternas fortsatta konstaterande på lokalerna kan vara av intresse eller också för att precisera lokaluppgifterna.

Områdets nordliga delar tillhöra till största delen den av odlade dalgångar genomskurna men eljest vilda och ödsliga skogs- och bergstrakt, vilken bär namnet Hanveden. Denna ännu blott ofullständigt kända vildmark, som sträcker sig in i alla de uppräknade socknarna, innehåller en rikedom av sjöar och mossar med för floristen tilltalande flora. Söder om Hanveden utbreder sig i Västerhaninge och Österhaninge socknar en sedan uråldriga tider odlad slättbygd. De berörda naturförhållandena ha nyligen närmare beskrivits av A. Sörlin i Sveriges Natur 1929, sid. 35—41. Särskilt längs områdets kuster — i nordost och sydost — påträffas talrika lövängar (fig. 1), där många mer eller mindre sällsynta arter ha sitt hemvist.

Nomenklaturen är för kärlkryptogamerna efter O. Holmberg, Skandinaviens flora h. 1, Stockholm 1922, och för fanerogamerna efter C. Lindman, Svensk fanerogamflora, 2 uppl., Stockholm 1926. Ortbenämningarna överensstämma i regel med ekonomiska kartbladet över Sotholms härad, uppmätt 1906. De viktigaste avvikelserna från det sistnämnda äro: Handens stn heter på kartan Österhaninge stn, Lyckebysjön kallas Lycksjön, Furunäs ligger på Fårudden, Vadviksvarvet på Vadsvikens östra sida.

Förkortningar: *T* = Tyresö socken, *D* = Dalarö socken, *Ö* = Österhaninge socken, *V* = Västerhaninge socken. St. V. = Stockholmstraktens växter, Stockholm 1914.

Actaea spicata. *T:* N om torpet Rotvik vid Öringesjön, Strand, torpen Brakmaren, Lillmyra och Mörkdalen. *D:* Vadviksvarvet. *Ö:* Schweizerdalen vid Dalarö (jfr St. V.).
Aethusa Cynapium. *T:* Öringe. *D:* Hotellbryggan vid Dalarö (jfr St. V.).
Agropyron caninum. *T:* Strand, torpet Brakmaren.
Agrostemma Githago. *T:* Öringe, där arten växte vid gårdsbyggnad. Inkommen med spillsäd.
Agrostis canina. *T:* Öringe, Karptjärn. *Ö:* mosse NO om Mörby. *V:* Västerhaninge, Tungelsta, St. Vädersjön.

A. Sörlin foto. 1926.

Fig. 1. Löväng vid Häringe i Västerhaninge socken. Stark kulturpåverkan har givit lövängen en parkartad karaktär.

A. capillaris f. *aristata.* *Ö:* Jordbro. *V:* Skogs-Ekeby.
Alchemilla acutangula. *D:* Dalarö.
A. micans. *V:* Häringe.
A. minor. *Ö:* Jordbro.
Alliaria officinalis. *T:* Brevik, torpet Brakmaren.
Alopecurus aequalis. *T:* Öringesjön N om torpet Rotvik.
Andromeda polifolia. *Ö:* Slätmossen NO om Jordbro, mosse NO om Mörby. *V:* Örasjön, St. Vädersjön.
Anthemis arvensis. *V:* Sågen.
Anthyllis Vulneraria. *D:* Furunäs. *Ö:* Sandemar, stranden vid Dalarövägen NO om Faholmen, nära torpet Södersund, Beteby. *V:* Skogs-Ekeby, Västnora.
Aquilegia vulgaris. *T:* Strand. *V:* förvildad vid Häringe.

Arabis arenosa. *Ö:* Handen stn, Jordbro hpl, ångsåg NV om kyrkan. *V:* Västerhaninge.
A. hirsuta. *T:* Strand, Brevik. *D:* Dalarö. *Ö:* Jordbro.
Arctium minus. *D:* Smådalarö. *Ö:* Svartbäcken, Tjursta, Stadsberga.
A. Lappa. *Ö:* Sanda.
Artemisia Abrotanum L. *Ö:* kvarstående efter gammal odling vid Ramsdal.
Asperugo procumbens. *T:* Brevik. *D:* Dalarö (jfr St. V.).
Asperula odorata. *T:* torpet Mörkdalen.
Balsamita vulgaris. *Ö:* kvarstående efter gammal odling vid Ramsdal.
Barbaraea stricta. *V:* mossdike Ö om kyrkan.
Berteroa incana. *D:* Hotellbryggan vid Dalarö (jfr St. V.).
Botrychium Lunaria. *Ö:* Handen.
f. *subincisum* Röper. *T:* Brevik. Ståndorten utgjordes av lundartade klippavsatser vända mot V.
Brachypodium silvaticum. *T:* torpet Brakmaren.
Bromus arvensis. *V:* Västerhaninge i åker med råg, alsikeklöver och rödklöver.
B. mollis var. *leiostachys.* *Ö:* Mörby.
Calamagrostis lanceolata. *T:* Öringesjön vid Öringe samt N om torpet Rotvik, Strand. *Ö:* Svartsjön, Hemträsk, gränsen till Västerhaninge socken vid vägen mellan kyrkorna.
Calla palustris. *Ö:* mosse V om Ramsjön, göl S om Lyckebysjön vid torpet Erikslund (jfr St. V.).
Callitriche polymorpha. *Ö:* Tyrsta, Sanda.
C. verna. *T:* Öringe. *Ö:* Mörby, mellan Småhamra och torpet Sandvreten, Högsta, Sanda, Stadsberga. *V:* Häringe.
Campanula glomerata. *V:* kyrkan, Berga, Västnora, Häringe.
C. latifolia. *T:* Strand, torpen Brakmaren och Lillmyra.
C. patula. *Ö:* torpet Erikslund. *V:* Västerhaninge.
C. rapunculoides. *D:* Smådalarö.
C. Trachelium. *T:* Strand, Brevik, torpet Brakmaren. *Ö:* torpet Erikslund. *V:* St. Vädersjön.
Cardamine hirsuta. *T:* Brevik.
C. impatiens. *T:* torpet Brakmaren.
Carduus crispus. *Ö:* Solberga, Länåker.
Carex caespitosa. *D:* Furunäs. *Ö:* NV om Kvarntäppan, Solberga, stranden vid Dalarövägen NO om Faholmen. *V:* Tungelsta, Häringe.
C. chordorrhiza. *Ö:* Handen. *V:* mosse S om Örasjön.
C. diandra. *Ö:* Handen. *V:* St. Vädersjön.
C. dioeca. *Ö:* NV om Kvarntäppan.
C. elata. *T:* Öringe. *Ö:* Jordbro. *V:* St. Vädersjön.
C. elongata. *Ö:* Handen, Högsta, Solberga. *V:* Tungelsta, St. Vädersjön, Häringe.
C. ericetorum. *Ö:* Handen, Jordbro.
C. flava. *Ö:* NV om Kvarntäppan, gränsen till Västerhaninge socken vid vägen mellan kyrkorna. *V:* St. Vädersjön, Sågen, Ö om kyrkan.
C. lasiocarpa. *T:* torpet Rotvik. *Ö:* Handen, Svartsjön, mosse NO om Mörby, gränsen till Västerhaninge socken vid vägen mellan kyrkorna. *V:* Örasjön, St. Vädersjön.

C. limosa. *Ö:* Handen. *V:* Örasjön.
C. magellanica. *Ö:* mosse NO om Mörby. *V:* Örasjön.
C. Pairaei. *D:* Smådalarö.
C. paradoxa. *Ö:* gränsen till Västerhaninge socken vid vägen mellan kyrkorna.
C. pauciflora. *Ö:* mosse V om Ramsjön, Slätmossen NO om Jordbro, mosse NO om Mörby. *V:* Örasjön.
C. pulchella. *Ö:* stranden vid Dalarövägen NO om Faholmen.
C. vulpina. *Ö:* nära kyrkan, Sanda. *V:* Tungelsta.
Carlina vulgaris. *T:* torpet Lillmyra. *Ö:* Valsta.
Centaurea Scabiosa. *Ö:* Handen.
Chenopodium bonus Henricus. *Ö:* kyrkan, S. Beteby, Länåker.
C. glaucum. *T:* Öringe, Strand. *Ö:* Högsta, Sanda, Länåker.
Chrysosplenium alternifolium. *V:* Häringe.
Cicuta virosa. *Ö:* göl S om Lyckebysjön vid torpet Erikslund.
Cirsium heterophyllum. *Ö:* NV om Kvarntäppan, Kalvsvik.
Conium maculatum. *T:* Öringe. *Ö:* V. Ösby, Länåker.
Corallorrhiza trifida. *Ö:* mellan Småhamra och torpet Sandvreten.
Crataegus coccinea L. *Ö:* en tämligen stor buske förvildad vid landsvägen N om Jordbro hpl. Sedd med frukt.
Crepis praemorsa. *Ö:* NV om Kvarntäppan. *V:* Sågen, Berga.
C. tectorum. *T:* Brevik. *D:* Furunäs. *Ö:* Svartbäcken, Sanda.
Cuscuta europaea. *Ö:* Länåker. Parasit på *Urtica dioeca.*
Cynoglossum officinale. *V:* Häringe.
Cynosurus cristatus. *Ö:* Tyrsta.
Daphne Mezereum. *D:* Vadviksvarvet.
Dentaria bulbifera. *T:* Brevik.
Draba muralis. *Ö:* kyrkan.
Drosera anglica. *T:* Karptjärn. *Ö:* Svartsjön. *V:* Örasjön.
D. intermedia. *D:* gropmossar på bergen NO om Vinåker. *Ö:* Handen, mosse V om Ramsjön, Svartsjön, Slätmossen NO om Jordbro, mosse NO om Mörby. *V:* Örasjön.
D. rotundifolia. *T:* Karptjärn. *D:* gropmossar på bergen NO om Vinåker. *Ö:* 7 lokaler antecknade. *V:* Örasjön, St. Vädersjön.
Dryopteris austriaca. *T:* N om torpet Rotvik vid Öringesjön, Strand. *D:* andra viken S om Furunäs. *Ö:* Högsta.
D. cristata. *T:* Karptjärn. *Ö:* Svartsjön, göl S om Lyckebysjön vid torpet Erikslund.
Echium vulgare. *Ö:* Länåker.
Empetrum nigrum. *Ö:* Jordbro, kyrkan, gränsen till Västerhaninge socken vid vägen mellan kyrkorna, Stadsberga. *V:* St. Vädersjön.
Epilobium collinum. *T:* Karptjärn, Brevik, Vissvass. *D:* Furunäs. *Ö:* Sanda. *V:* St. Vädersjön.
E. parviflorum. *D:* Furunäs.
E. rubescens. *D.* Smådalarö. *Ö:* Sanda. *V:* Ö om kyrkan.
Equisetum hiemale. *Ö:* Handen, Jordbro.
E. palustre. *Ö:* Handen, Kalvsvik, Solberga. På sistnämnda lokalen jämte f. *polystachyum.*

Equisetum pratense. *T:* Brevik. *V:* Västerhaninge, Häringe.
Eriophorum latifolium. *Ö:* NV om Kvarntäppan. *V:* Örasjön.
E. vaginatum. *T:* Karptjärn. *Ö:* 5 lokaler antecknade. *V:* Örasjön, St. Vädersjön.
Erodium cicutarium. *Ö:* Ramsdal, Svartbäcken. *V:* Västerhaninge.
Galium Mollugo. *T:* Vissvass. *D:* flerstädes. *Ö:* nära kyrkan, Högsta. *V:* Ö om kyrkan, Skogs-Ekeby.
G. Mollugo × *verum.* *D:* Smådalarö. Tillsammans med föräldrarna.
Gentiana Amarella **lingulata.* *D:* Furunäs.
G. campestris **suecica.* *Ö:* Ramsdal.
Geranium pusillum. *T:* Brevik. *D:* Furunäs. *Ö:* Ramsdal, kyrkan.
Geum rivale × *urbanum.* *V:* Häringe. Tillsammans med föräldrarna.
Goodyera repens. *T:* Strand. *Ö:* Högsta, mellan Småhamra och torpet Sandvreten.
Helleborine palustris. *Ö:* gränsen till Västerhaninge socken vid vägen mellan kyrkorna.
Herniaria glabra. *D:* Dalarö.
Hesperis matronalis. *T:* torpet Brakmaren. *D:* Dalarö. *Ö:* kyrkan. På alla ställen förvildad.
Hierochloë odorata. *T:* Strand, Breviksmaren. *D:* Smådalarö. *Ö:* NV om Kvarntäppan, Solberga, stranden vid Dalarövägen NO om Faholmen.
Hippuris vulgaris. *Ö:* Handen, göl S om Lyckebysjön vid torpet Erikslund.
f. *fluviatilis* Hoffm. *T:* Öringesjön N om torpet Rotvik.
f. *litoralis.* *Ö:* Länåkersviken vid Valsta, stranden vid Dalarövägen NO om Faholmen.
Holcus mollis. *Ö:* Svartbäcken. Tämligen talrik på liten fläck i kanten av havreåker.
Hottonia palustris. *T:* Öringesjön vid Öringe. *Ö:* Handen, göl S om Lyckebysjön vid torpet Erikslund.
Humulus Lupulus. *Ö:* förvildad vid Sanda.
Hydrocharis Morsus ranae. *T:* torpet Rotvik. *Ö:* göl S om Lyckebysjön vid torpet Erikslund.
Jasione montana. *T:* N om torpet Rotvik, Brevik, torpet Lillmyra.
Juncus filiformis. *Ö:* Sanda, Hammarby, mellan Småhamra och torpet Sandvreten, mosse NO om Mörby. *V:* Västerhaninge, Tungelsta.
J. supinus. *T:* torpet Rotvik, Karptjärn. *D:* gropmossar på bergen NO om Vinåker. *Ö:* mosse NO om Mörby.
var. *fluitans.* *Ö:* Svartsjön.
Lathyrus niger. *T:* Brevik, torpet Brakmaren. *Ö:* torpet Erikslund.
L. silvestris. *T:* torpet Mörkdalen.
L. vernus. *T:* torpen Brakmaren och Mörkdalen, Vissvass. *D:* Vadviksvarvet. *Ö:* torpet Erikslund. *V:* St. Vädersjön.
Ledum palustre. *T:* Karptjärn. *Ö:* 5 lokaler antecknade. *V:* Örasjön, St. Vädersjön.
Leonurus Cardiaca. *Ö:* V. Ösby.
Levisticum paludapifolium. *Ö:* förvildad vid Ramsdal.
Linnaea borealis. *T:* Strand.
Listera cordata. *Ö:* Högsta. *V:* Örasjön.

Listera ovata. *T:* Brevik. *V:* Häringe.
Lycopodium Selago. *Ö:* flerstädes kring Svartsjön och södra delen av Lyckebysjön, Högsta, mellan Småhamra och torpet Sandvreten.
Lycopus europaeus. *T:* Öringesjön. *Ö:* Handen. *V:* St. Vädersjön.
Melandrium album. *Ö:* Jordbro, vägen mellan Dalarö och Sandemar.
M. dioecum. *D:* Smådalarö. *Ö:* Sanda. *V:* Västnora, Häringe.
Melica uniflora. *T:* i mängd nära torpet Brakmaren.
Milium effusum. *T:* Strand, SO om torpet Ektorp, torpen Brakmaren och Mörkdalen. *Ö:* Valsta, Hemträsk. *V:* St. Vädersjön.
Monotropa Hypopitys. *D:* Smådalarö. *Ö:* nära kyrkan, Högsta, mellan Småhamra och torpet Sandvreten.
Montia lamprosperma. *T:* Breviksmaren.
Myosotis baltica. *D:* Furunäs.
Myrica Gale. *T:* Öringesjön, Karptjärn. *Ö:* 8 lokaler antecknade. *V:* Örasjön, St. Vädersjön.
Myriophyllum alterniflorum. *T:* Öringesjön. *Ö:* Svartsjön, göl S om Lyckebysjön vid torpet Erikslund samt i tilloppsdiket till densamma. *V:* Örasjöns avloppsdike mot S.
M. spicatum. *Ö:* Länåkersviken vid Valsta.
Nardus stricta. *Ö:* Svartsjön, NV om Kvarntäppan, nära torpet Trumpa.
Odontites serotina. *Ö:* Svartbäcken, Sanda.
O. verna. *T:* Vissvass.
Oenanthe aquatica. *Ö:* Handen. *V:* Tungelsta.
Ophioglossum vulgatum. *T:* Breviksmaren. *Ö:* stranden vid Dalarövägen NO om Faholmen.
Orchis incarnatus. *D:* Furunäs. *Ö:* stranden vid Dalarövägen NO om Faholmen
Origanum vulgare. *T:* N om torpet Rotvik. *Ö:* torpet Erikslund.
Oxycoccus quadripetalus. *T:* Karptjärn. *Ö:* 5 lokaler antecknade. *V:* Örasjön, St. Vädersjön.
Papaver dubium. *Ö:* Beteby.
Peplis Portula. *Ö:* mellan Småhamra och torpet Sandvreten. Växte tillsammans med *Callitriche verna* på gammal väg, där denna löpte genom sankmark.
Poa irrigata. *D:* Furunäs. *Ö:* Länåkersviken vid Valsta, stranden vid Dalarövägen NO om Faholmen. *V:* Västerhaninge, Östnora.
P. subcaerulea. *D:* Furunäs. *Ö:* Sanda, nära torpet Trumpa.
Polygonum amphibium. *T:* Öringesjön. *Ö:* Tyrsta, Länåker.
P. dumetorum. *T:* N om torpet Rotvik, Strand. *Ö:* torpet Erikslund.
P. Persicaria. *D:* Smådalarö.
Potamogeton alpinus. *Ö:* torpet Erikslund. *V:* Tungelsta.
P. filiformis. *T:* Åvaviken.
P. natans. *T:* Öringesjön, Karptjärn. *Ö:* Handen.
P. obtusifolius. *T:* Öringesjön.
P. pusillus. *T:* Karptjärn, Breviksmaren. *Ö:* Mörby.
Potentilla norvegica. *D:* Dalarö (jfr St. V.), Vadviksvarvet. *Ö:* Handen stn.
Primula farinosa. *Ö:* stranden vid Dalarövägen NO om Faholmen.
Prunus avium. *D:* Dalarö, Smådalarö. *V:* V om Västerhaninge.
Pulmonaria officinalis. *V:* St. Vädersjön.

Pyrola chlorantha. *Ö:* Högsta, Hemträsk. *V:* Örasjön.
P. media. *D:* Furunäs.
Radicula palustris. *Ö:* göl S om Lyckebysjön vid torpet Erikslund, Sanda, Mörby.
Ranunculus Lingua. *Ö:* göl S om Lyckebysjön vid torpet Erikslund.
R. paucistamineus. *V:* Tungelsta.
Rhamnus cathartica. *T:* Strand, Brevik, SO om torpet Ektorp. *Ö:* Valsta. *V:* V om Västerhaninge.
Rhynchospora alba. *T:* Karptjärn. *D:* gropmossar på bergen NO om Vinåker. *Ö:* mosse V om Ramsjön, mosse NO om Mörby. *V:* Örasjön.
R. fusca. *D:* gropmossar på bergen NO om Vinåker. *V:* Örasjön.
Rosa pimpinellifolia. *Ö:* planterad eller förvildad i ljungbacke vid vägen mellan Dalarö och Sandemar. I Riksmuseets herbarium finnes en liten kvist, insamlad på samma lokal i augusti 1916 av Sten Selander. Enligt anteckning på etiketten skulle vid detta tillfälle iakttagits ett 30-tal låga buskar växande i den omgivande skogen. Själv gjorde jag inga närmare efterforskningar men lade märke till ett par små buskar — vid tillfället ifråga med stora blomknoppar — växande alldeles intill landsvägen.
Rubus chamaemorus. *T:* Karptjärn. *Ö:* mosse V om Ramsjön, Svartsjön, Slätmossen NO om Jordbro, mosse NO om Mörby. *V:* St. Vädersjön.
R. Wahlbergii. *D:* flerstädes (jfr St. V.) t. ex. Smådalarö samt andra viken S om Furunäs.
Rumex crispus × *domesticus.* *Ö:* Sanda, Beteby. På båda lokalerna tillsammans med föräldrarna.
R. crispus × *obtusifolius.* *Ö:* Beteby. Tillsammans med föräldrarna.
R. domesticus × *obtusifolius.* *T:* Spirudden. *Ö:* Sanda, Beteby. På alla lokalerna tillsammans med föräldrarna.
Scheuchzeria palustris. *Ö:* mosse NO om Mörby. *V:* Örasjön.
Scirpus acicularis. *T:* Öringesjön vid Öringe samt N om torpet Rotvik.
S. austriacus. *Ö:* Slätmossen NO om Jordbro. Ny för Södertörn. Inom Stockholmstrakten förut säkert känd blott från Ingarö, där den år 1927 upptäcktes av Erik Almquist.
S. compressus. *Ö:* stranden vid Dalarövägen NO om Faholmen.
S. mamillatus. *Ö:* Handen. *V:* St. Vädersjön.
S. Trichophorum. *T:* Karptjärn. *Ö:* Handen, NV om Kvarntäppan, gränsen till Västerhaninge socken vid vägen mellan kyrkorna.
Scleranthus perennis. *T:* Öringe, torpet Rotvik. *V:* Västerhaninge, Skogs-Ekeby.
Scorzonera humilis. *Ö:* Jordbro på svedd sandmark vid järnvägen.
Scrophularia vernalis. *D:* Dalarö rikligt utanför Pensionat Floryhof (jfr St. V.).
Selinum Carvifolia. *Ö:* Mörby.
Senecio silvaticus. *T:* Öringe, Karptjärn. *D:* Smådalarö. *Ö:* Sanda.
Silene vulgaris. *D:* Dalarö, Smådalarö. *V:* Ö om kyrkan.
Sisymbrium Sophia. *T:* Öringe. *D:* Hotellbryggan vid Dalarö. *Ö:* Tjursta, V. Ösby.
Solanum Dulcamara. *Ö:* ångsåg NV om kyrkan, Beteby, Länåker.

N. Andersson foto. 1928.

Fig. 2. *Struthiopteris Filicastrum* i bäckdal strax norr om Västerhaninge kyrka.

Sparganium minimum. *T:* torpet Rotvik, Karptjärn. *Ö:* mosse V om Ramsjön.
S. ramosum. *Ö:* Sanda, Mörby.
Spergula vernalis. *Ö:* Jordbro, Högsta.
Spergularia rubra. *Ö:* Svartbäcken.
Stachys silvaticus. *T:* SO om torpet Ektorp, torpet Brakmaren. *D:* Vadviksvarvet. *V:* V om Västerhaninge.
Struthiopteris Filicastrum. *V:* Västerhaninge i bäckdal N om kyrkan (fig. 2) tillsammans med *Athyrium Filix femina, Dryopteris Phegopteris, D. spinulosa, Scirpus silvaticus* m. fl. Lokalen är omnämnd av A. Sörlin i Sveriges Natur 1929, sid. 38. Sannolikt har redan D. H. Söderberg sett arten på denna lokal, innan han uppgav den från samma trakt med frekvensbeteckningen »passim» i sin avhandling »Pandora et flora

Rybyensis» (Diss. Uppsala 1771). Egendomen Ribby (Ryby) är nämligen belägen strax S om Västerhaninge kyrka.

Subularia aquatica. *T:* Öringesjön N om torpet Rotvik.

Symphytum asperum. *Ö:* förvildad vid kyrkan.

Thalictrum flavum. *T:* Strand.

Thymus Chamaedrys. *Ö:* Jordbro.

Tilia cordata. *T:* Brevik. *D:* andra viken S om Furunäs. *Ö:* torpet Erikslund.

Trifolium agrarium. *T*: Öringe, torpen Brakmaren och Mörkdalen. *Ö:* Tyrsta, Sanda, Mörby.

T. procumbens. *Ö:* Valsta.

T. spadiceum. *D:* Furunäs samt andra viken S därom. *V:* Västerhaninge, St. Vädersjön.

Typha angustifolia. *T:* Öringesjön.

T. latifolia. *T:* Öringesjön, Karptjärn. *Ö:* nära torpet Södersund, Hemträsk. *V:* nära kyrkan.

Ulmus glabra. *T:* Brevik, torpen Brakmaren och Lillmyra. *Ö:* förvildad vid kyrkan, Sanda.

Utricularia intermedia. *T:* torpet Rotvik. *Ö:* Handen.

U. minor. *T:* torpet Rotvik.

U. vulgaris. *T:* Öringesjön vid Öringe, torpet Rotvik. *V:* mosse S om Örasjön.

Vaccinium uliginosum. *T:* Karptjärn. *Ö:* 8 lokaler antecknade. *V:* Sågen, St. Vädersjön.

Valeriana officinalis. *T:* Strand. *Ö:* Solberga, stranden vid Dalarövägen NO om Faholmen.

V. salina. *D:* Furunäs, Smådalarö, Dalarö.

Valerianella olitoria. *T:* Breviksmaren. *D:* Furunäs.

Verbascum nigrum. *Ö:* Tjursta, Valsta.

Veronica Beccabunga. *D:* Furunäs, Smådalarö. *Ö:* NV om Kvarntäppan. *V:* Ö om kyrkan.

V. scutellata f. *villosa.* *V:* mosse S om Örasjön.

Vicia silvatica. *T:* torpet Mörkdalen. *D:* Smådalarö, Vadviksvarvet. *V:* Häringe.

V. villosa. *D:* Smådalarö. *Ö.* Hammarby. Arten växte på det förra stället i tvåradskorn, på det senare i råg.

Vinca minor. *Ö:* förvildad vid kyrkan.

Viola mirabilis. *T:* Strand, torpet Mörkdalen. *Ö:* torpet Erikslund.

Saltsjö-Storängen i oktober 1929.

Ingmar Fröman.

Berberis i Södertörn.

E. Henning gjorde för ett tiotal år sedan en utredning av berberisbuskens förekomst i Sverige, och det visade sig därvid, att den var synnerligen ojämnt fördelad inom landet. Då det likaså förefallit, som om dess lokalutbredning inom mindre områden är synnerligen ojämn, och de uppgifter,

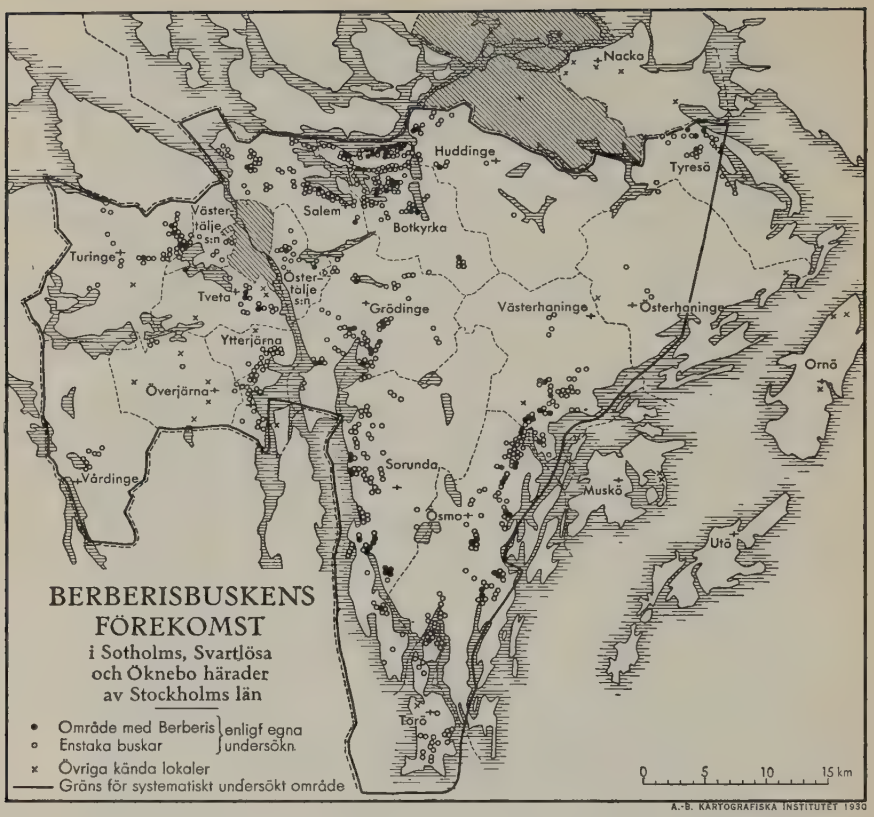

Fig. 1.

man av ortsbefolkningen erhållit, varit otillfredsställande, syntes det mig vara mödan värt att utföra en systematisk undersökning av ett mindre område. E. Almqvist har i sitt stora arbete »Upplands vegetation» gett oss en karta över berberisbuskens utbredning i Uppland. Av denna karta framgår med den största tydlighet, att *Berberis* har en mycket olika lokal utbredning. Vi finna den i huvudsak koncentrerad till Furusundsleden, Stockholms närmaste omgivningar, vattenvägen till Uppsala samt Mälaren med dess vikar; slutligen ha vi ett mindre område i Öregrundstrakten.

Min undersökning avsåg dels att ge en anknytning till Almqvists karta, då ju denna tydligt visar, att *Berberis*' utbredning har en nord-sydlig orientering, dels att komplettera kännedomen om artens utbredning i Stockholms län för att underlätta en eventuell, systematisk utrotning. Jag har därför inskränkt materialsamlandet att omfatta endast Södertörns domsaga med undantag för de östliga ösocknarna samt Nacka socken, vilken till sin karaktär genom bebyggelsens täthet mer kan räknas till Stockholms stad.

Undersökningen utfördes på så vis, att en man, som mycket deltagit i *Berberis*-utrotning, rättaren N. Aldrin, under ca. 1 ½ månads tid på hösten, då löven fallit och berberisbusken med sina röda bärklasar på långt håll

signalerar sin förekomst, systematiskt genomletade området beträffande buskens förekomst framför allt i åkerkanter. Lokalen inlades direkt på en medhavd ekonomisk karta med olika tecken för enstaka buskar och mer slutna förekomster.

Materialet kompletterades genom de upplysningar »Stockholmstraktens växter» lämnar samt med välvilliga meddelanden från fil. dr. E. Asplund och fil. stud. I. Fröman. I de fall, då fyndorten ej redovisats genom min egen undersökning, anges dessa lokaler med ett ×.

Dessutom har jag vid talrika exkursioner noterat fyndplatser för *Berberis*. Likaså har jag uttagit en del stickprov och kontrollerat den systematiska undersökningens riktighet.

Resultatet av denna undersökning finna vi å kartan (fig. 1). Denna avser ju ej att redovisa varenda buske utan endast att ge en bild av fördelningen.

Som synes är utbredningen synnerligen olikformig. Vi kunna urskilja fyra centra, vilka jag skulle vilja kalla: Häringeområdet på östra sidan av Södertörn, Fituna-Fållnäsområdet på västra, Mälareområdet på norra kusten av Södertörn samt Måsnarenområdet runt nämnda sjö. Man frågar sig ovillkorligen efter orsaken till denna utbredning. I allmänhet betraktas *Berberis* som kulturbunden, den skulle ha införts som prydnadsväxt och sedan ha spritt sig. I synnerhet skulle den ha kommit från de större herrgårdarna.

Men se vi till kartan, finna vi, att så ej kan vara fallet. Åtminstone synes det ej vara troligt, t. ex. då vi ha lika mycket herrgårdar i Östersom Västerhaninge.

Att *Berberis* tidigare ej blivit så observerad som nu torde vara beroende av tre orsaker:

1) Uppmärksamheten är numera mycket mer än förr riktad på denna växt på grund av den anti-Berberispropaganda, som bedrivits under senaste tid.

2) På grund av den olikformiga utbredningen kan dess förekomst endast bestämmas genom systematiska undersökningar och dylika ha ej förrän i senare tid blivit så vanliga.

3) *Berberis*-förekomsterna torde ha blivit rikare och större under den sista delen av det gångna århundradet, då först under denna tid den starka skogsskövlingen ägt rum i Stockholmstrakten. Och busken, som är ljusälskande, har då kunnat nå en ofantligt mycket rikare utveckling än förut.

Att den särskilt starkt förekommer i åkerkanter behöver ju ej betyda, att den är kulturbunden utan fastmer att den liksom slån, nypon o. s. v. just föredrar de ljusöppna lokalerna.

Vad som emellertid är mest slående ifråga om buskens utbredning, är dess förekomst i närheten av vattenlederna från Södertörns södra del till Dalälven. *Berberis* måste spridas genom någon fågel, som antingen har sin hemvist längs vattendragen eller också flyttar längs dessa.

Henning omnämner sidensvansen såsom en av spridarna, men det är föga troligt, att denna är den enda. Mera troligt är ju, att vi ha att söka den bland de mer vanliga fåglarna.

O. Arrhenius.

SVENSKA BOTANISKA FÖRENINGEN.

Revisionssammanträde.

Föreningen sammanträdde den 3 maj 1930 å Stockholms Högskola under ordförandeskap av professor R. Sernander.

Sedan närmast föregående sammanträde hade föreningen genom döden förlorat tre av sina medlemmar, nämligen rådmannen Sten Svenson, Falkenberg, godsägaren A. L. Segerström, Stockholm, samt läroverksadjunkten T. Vestergren, Stockholm. Ordföranden ägnade de avlidne några erkännsamhetens minnesord och erinrade därvid särskilt om de tvenne sistnämnde, som under en följd av år tillhört föreningens funktionärer. Till ersättare för läroverksadjunkten Vestergren i redaktionskommittén valdes lektor G. Malme.

Sedan revisionsberättelsen upplästs, beviljade föreningen i anslutning till revisorernas förslag styrelsen och skattmästaren full och tacksam ansvarsfrihet för 1929 års förvaltning.

På grund av den under senare år fortgående minskningen av medlemsantalet vädjade ordföranden till de närvarande att anskaffa nya medlemmar till föreningen.

För att förbereda och leda föreningens vårutflykt, vilken enligt styrelsens beslut skulle äga rum den 1 juni och ställas till Ornö i Stockholms skärgård, tillsattes en kommitté, bestående av fil. dr. E. Asplund, docenten O. Heilborn och amanuensen E. Söderberg.

Vid sammanträdet höll professor O. Juel ett med talrika skioptikonbilder belyst föredrag om växter med subterran fruktbildning, vilket åtföljdes av en livlig diskussion, och professor R. Fries demonstrerade ett blommande exemplar av *Alpinia speciosa* från Bergianska Trädgården.

Revisionsberättelse.

Undertecknade, utsedda att granska Svenska Botaniska Föreningens räkenskaper för år 1929, få härmed avgiva följande berättelse.

Allmänna kassan.

Behållning från 1928			666: 48

Inkomster.

Statsanslag		1 500: 00	
Medlemsavgifter för 1928	60: 00		
Medlemsavgifter för 1929	5 595: 00		
Medlemsavgifter för 1930	45: 00	5 700: 00	
Försålda årgångar av tidskriften		640: 37	
Ersättning för separat m. m.		408: 63	
Upplupna räntor		63: 73	
Överfört från grundfonden		2 000: 00	
Överfört från dispositionsfonden		1 033: 00	11 345: 73
		Kronor	12 012: 21

Utgifter.

Årgång 1929 av tidskriften	8 249: 26	
Arvoden	1 661: 65	
Porto, trycksaker m. m.	730: 58	
Sammanträden	100: 50	
Biblioteket	330: 54	
Diverse utgifter	91: 15	11 163: 68
Behållning till 1930 å sparkasseräkning och postgiro		848: 53
	Kronor	12 012: 21

Registerfonden.

Behållning från 1928		2 102: 76
Ränta å bankräkning		67: 91
	Kronor	2 170: 67
Behållning till 1930 innestående å sparkasseräkning		2 170: 67

Fonden för engångsavgifter.

Behållning från 1928		2 817: 69
Upplupna räntor		157: 26
	Kronor	2 974: 95
Behållning till 1930		2 974: 95

Grundfonden.

Behållning från 1928		30 511: 46
Upplupna räntor		1 564: 93
Värdeökning å obligation		25: 00
	Kronor	32 101: 39
Överfört till allmänna kassan		2 000: 00
Behållning till 1930		30 101: 39
	Kronor	32 101: 39

Dispositionsfonden.

Behållning från 1928	15 172: 82
Upplupna räntor	905: 18
Kronor	16 078: 00
Överfört till allmänna kassan	1 033: 00
Behållning till 1930	15 045: 00
Kronor	16 078: 00

Fondernas värdehandlingar, förvarade i A.-B. Svenska Handelsbanken, hava utan anmärkning granskats av undertecknad Segerström i samband med revisionen.

Föreningens medlemsantal, som vid 1928 års slut utgjorde 422, uppgick vid årets utgång till 407.

Räkenskaperna äro förda med ordning och alla utgifter försedda med vederbörliga verifikationer, varför vi föreslå, att föreningen beviljar styrelsen och skattmästaren full och tacksam ansvarsfrihet för 1929 års förvaltning.

Stockholm den 20 febr. 1930.

A. L. Segerström. *Govert Indebetou.*

Nya medlemmar.

Vid styrelsens sammanträde den 3 maj 1930 invaldes följande medlemmar:
på förslag av fil. stud. Ingmar Fröman:
fil. stud. Bror Jahrl, Stockholm;
på förslag av professor O. Rosenberg:
fil. dr. H. B. Goodwin, Stockholm;
på förslag av fil. mag. Gunnar Björkman:
fil. stud. Sven Gaunitz, Borensberg;
på förslag av lektor J. A. O. Skårman:
överläkaren Nils Holmin, Stockholm,
överläkaren, docenten Oscar Lindblom, Stockholm.

Föreningens vårutflykt.

Söndagen den 1 juni 1930 företogs föreningens sedvanliga vårutflykt, i år med norra delen av Ornö som mål. Tack vare den tidiga våren fingo exkursionsdeltagarna tillfälle att se skärgårdsfloran i mera utvecklat stadium än under de närmast föregående årens vårexkursioner. Tyvärr hade den torra väderleken utövat ett mycket ogynnsamt inflytande på hällmarkernas vegetation.

Avfärden gjordes från Räntmästaretrappan kl. 9,45 med ångfartyget »Eskilstuna Express», som förhyrts för exkursionen. Trots ogynnsamt väder deltogo 67 personer. Kl. 12,30 anlände båten till Ornö, där landstigningen tack vare tillmötesgående från direktör Oscar Johanson kunde ske på en

honom tillhörig brygga omedelbart invid öns vackraste lövängsområde. Under promenad fram till Svinåkers gård iakttogos bl. a. följande arter: *Melica uniflora, Brachypodium silvaticum, Carex Pairaei, Cephalanthera grandiflora, Neottia nidus avis, Coeloglossum viride, Actaea spicata, Dentaria bulbifera, Lathyrus niger, Sanicula europaea, Laserpitium latifolium, Lathraea squamaria, Asperula odorata.*

På hällmarkerna vid gården och längs vägen västerut: *Asplenium ruta muraria, Woodsia alpina, Botrychium matricariifolium* (1 ex. funnet av fil. kand. Th. Arwidsson), *Draba muralis, Saxifraga tridactylites, Vicia lathyroides, Geranium columbinum, lucidum* och *molle* (dessa tre endast i få och magra exemplar). Invid norra ändan av Hemträsket sågos *Dryopteris thelypteris, Carex riparia* och *Listera cordata.*

Kl. 15,30 avgick båten till Hesselmara brygga. Ungefär hälften av exkursionsdeltagarna medföljde ombord, resten föredrog trots en rätt kraftig regnskur en promenad. Vid Hesselmara besöktes den nordligaste kända fyndorten för *Aira caryophyllea,* vilken upptäcktes år 1902 av dr. H. Dahlstedt. Växten finnes fortfarande mycket rikligt på lokalen, en sandbacke med tämligen sluten gräsvegetation (mest *Agrostis tenuis*) mellan V. och Ö. Hesselmara.

Kl. 17,30 lämnade båten Hesselmara och anlände efter färd genom Hammarbyleden till Riddarholmen kl. 21,30.

Erik Asplund.

Nyförvärv till föreningens bibliotek.

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Från Botanisches Institut, Jena:
5 separat.
Från Botanisches Institut, Leipzig:
2 separat.

SAMMANTRÄDEN.

Botaniska Sektionen av Naturvetenskapliga Studentsällskapet i Uppsala.

Den 21 januari 1930.

Professor S. Odén höll föredrag om »Växtfysiologiska rön och erfarenheter vid de elektriska belysningsförsöken vid Experimentalfältet». Föredraget illustrerades med planscher och talrika skioptikonbilder.

Den 11 februari 1930.

Amanuens Gunnar Johansson höll föredrag om »Sjöundersökningar i Norrbotten» och visade i samband därmed apparatur, tabeller och skioptikonbilder. (Föredraget kommer att tryckas.)

Den 25 februari 1930.

Professor R. Sernander höll ett föredrag betitlat »Ur Stockholms naturskyddsarkiv». Föredr. visade i samband härmed prov ur arkivet, vidare talrika skioptikonbilder och levande blommande material av *Hedera helix* från Stockholm.

Den 11 mars 1930.

Fil. kand. H. Bruun höll föredrag om »*Primula*, cytologi och systematik». Föredraget illustrerades med preparat, talrika bilder och pressat material. (Föredraget kommer att tryckas.)

Den 24 mars 1930.

Docent D. Melin höll föredrag om »Myrmekofila växter»; dessa borde enligt föredr. rättare kallas myrmekofyta. I samband med föredraget visades bilder ur tryckta arbeten, egna fotografier och pressat material. (Jfr D. Melin, Contributions to the Study of the Theory of Selection I., Zoologiska bidrag från Uppsala, Bd. 13, Uppsala 1930.)

Den 15 april 1930.

Professor N. Svedelius höll föredrag om

De s. k. sötvattens-Lithodermorna.

Föredr. meddelade, att han funnit plurilokulära sporangier hos den art, som hittills gått under namnet *Lithoderma fluviatilis* Aresch. Sporangiernas form och bildningssätt visade emellertid så stora olikheter från förut beskrivna *Lithoderma*-arter, att denna alg icke vidare kunde föras till detta släkte. Den vore enligt vad föredr. iakttagit fleråriq med periodiskt tillväxande förtjockningsskikt. Enligt föredr. överensstämde den med Gomont's släkte *Heribaudiella*, varför algen enligt nomenklaturreglerna bör kallas *H. fluviatilis* (Aresch.) Sved. (Autoreferat.)

I samband med föredraget visades konserverat material och talrika skioptikonbilder. (Föredraget kommer att tryckas i Zeitschrift für Botanik.)

Fil. kand. J. A. Nannfeldt visade uredinéen *Uropyxis mirabilissima* på *Mahonia* från en handelsträdgård i Linköping. (Jfr J. A. Nannfeldt, En skadesvamp på mahonia, *Uropyxis mirabilissima*, stadd i stark spridning, Bot. Not., 1930.)

Den 6 maj 1930.

Amanuens S. Junell höll föredrag om

Embryologien hos Circeaster agrestis Maxim.

Talförhållandena i blommorna visa ganska stora växlingar. Ibland kunna märkespapiller utbildas på ståndarknapparna.

Pollenbildning simultan. Periplasmodium utbildas ej.

Varje pistill består av ett fruktblad, på vars insida anläggas två fröämnen. Utav dessa utvecklas endast det ena. Det andra degenererar på ett ganska tidigt stadium. Det orthotropa fröämnet är tenuinucellat, syndermalt och unitegmiskt. En av de få arkesporcellerna utbildas till embryosäckmodercell. Den chalazala tetradcellen utvecklar sig till embryosäck enligt normaltyp. Antipoderna äro stora och förstoras ytterligare, om befruktning utebliver. Pollenslangar tränga in i nucellus nedanför antipoderna och växa sedan innanför nucellusepidermis upp mot äggapparaten. Här föreligger således chalazogami. Endospermet är cellulärt, och den första väggen är longitudinell. Nucellus och integument degenerera. Fröskal utbildas således ej, utan endospermet kommer att omgivas direkt av fruktväggen. Den basala delen av endospermet synes ha en näringsupptagande funktion. På äldre stadium avskiljes denna basala endospermdel från det övriga endospermet, genom att ett cellager på övergången mellan de båda avdelningarna förkorkas. Även ytterväggarna i den övre endospermavdelningens perifera celler förkorkas.

Diploida kromosomtalet 30. (Autoreferat.)

I samband med föredraget visades levande material och talrika bilder. (Föredraget kommer att tryckas.)

Fil. kand. Th. Arwidsson höll föredrag om »Fortplantningsorganen hos *Caulerpa*» och visade i samband därmed konserverat material och bilder. (Se Sv. Bot. Tidskr., 1930, sid. 263.)

Fil. kand. J. A. Nannfeldt refererade M. A. Guilliermond, Recherches sur quelques Ascomycètes inférieurs isolés de la stigmatomycose des graines de Cotonnier, Essai sur la phylogénie des Ascomycètes, Revue générale de Botanique, Tome 40, Paris 1928.

Docent O. Dahlgren höll föredrag om »Endospermutvecklingen hos några saxifragacéer» och demonstrerade i samband därmed ett antal bilder. Hos ett par *Astilbe*-arter hade konstaterats ett cellulärt endosperm (Webb har avbildat fria kärnor). Samma typ finnes hos *Peltiphyllum peltatum*, *Heuchera cylindrica*, *Boykinia occidentalis* och *Mitella pentandra*. Hos *Boykinia tellimoides* och *Mitella diphylla* utbildas däremot ett helobieartat endosperm. Samma släkte kan alltså uppvisa två olika endospermtyper, men dessa äro tydligen här endast olika modifikationer av samma grundtyp. (Föredraget kommer att tryckas.)

Den 21 maj 1930.

Sammanträde på Linnés Hammarby.

Professor R. Sernander demonstrerade trädgården, byggnaderna och samlingarna.

Professor R. Sernander höll föredrag om »Linnés Hammarby och Uppsala-professorernas tuscula».

NOTISER.

Botanistkongressen i Cambridge. — I den femte internationella botanistkongressen, som hålles i Cambridge den 16—23 augusti 1930, deltaga följande svenska botanister: professor O. Juel som kongressens vicepresident, professor N. Svedelius som svenska statens representant och vicepresident inom sektionen för morfologi, professor O. Rosenberg som president inom sektionen för genetik och cytologi, professor R. Fries som vicepresident inom sektionen för systematik och nomenklatur, professor C. Skottsberg som vicepresident inom sektionen för växtgeografi och ekologi, professor T. Halle som vicepresident inom sektionen för paleobotanik, professor H. Lundegårdh som vicepresident inom sektionen för fysiologi, samt dessutom professor G. Samuelsson, professor E. von Post, docenten G. E. du Rietz, docenten E. Melin och fil. dr. G. Erdtman.

Kurs i algologi vid Londons universitet. — På inbjudan av universitetet i London har professor N. Svedelius, Uppsala, den 20, 22 och 23 maj 1930 hållit 3 föreläsningar över ämnet »The Bearing of Modern Researches on Algae, especially Rhodophyceae».

Doktorsdisputation. — För vinnande av filosofie doktorsgrad försvarade fil. lic. Carl Philipson den 22 maj 1930 å Stockholms Högskola en avhandling »Growth and Absorption by Oats in Relation to varying Concentrations of Calcium and Sodium in the Nutrient Solution».

Stipendier. — Ur Liljevalchska fonden ha utdelats följande stipendier: till fil. mag. T. Norstad, Uppsala, 1500 kronor för att under 2 månader i utländska trädgårdar insamla och konservera material till en undersökning över den fruktifikativa morfologien hos *Campanulaceae, Lobeliaceae* och närstående familjer; till fil. mag. Gunnar Johansson, Uppsala, 1600 kronor för 2 ½ månaders resor i mellersta och norra Sverige för undersökningar över den svenska vattenvegetationen; till fil. kand. Th. Arwidsson, Uppsala, 1000 kronor för 1 ½ månads resa i algologiskt syfte till Norges södra och västra kust. Naturvetenskapliga Studentsällskapet i Uppsala har tilldelat fil. lic. Erik Marklund sitt Linné-stipendium för insamling av cytologiskt *Salix*-material i Torne Lappmark; samma sällskaps botaniska sektion har tilldelat fil. stud. Nils Hylander sitt Elias Fries-stipendium för studium av säsongdimorfismen hos rhinanthoideerna i Östergötland.

Avliden bryolog. — F. d. stationsinspektoren Alfred Arvén, född 1845, avled den 28 mars 1930 i sitt hem i Gränna. Han var botaniskt livligt intresserad och inriktade sig med tiden alltmera på mossornas studium. Några år före sin död skänkte han sin ganska rika, huvudsakligen svenska mossamling till Naturhistoriska Riksmuseum.

1
4
10
8

Fig. 1—6 & 9. *Draba daurica* f. f. 7 & 10. *Draba groenlandica*. 8. *Draba cinerea*.

Svensk Botanisk Tidskrift. 1930. Bd. 24, H. 3.

THE FUNDAMENTAL UNITS OF BIOLOGICAL TAXONOMY.

BY

G. EINAR DU RIETZ.

1. Introduction.

Though the species is generally accepted by present-day biologists (some geneticists excepted) as the most fundamental unit of biological taxonomy, certainly very few biologists of our days would be able to give a clear definition of what a species really is.

The main causes to that vague species-concept certainly must be sought for in historical facts. The evolution-theories of Lamarck (1802, 1809) and Darwin (1859) had led to a general belief in the gradual transformation of species. That »Natura non facit saltus» was doubted by very few biologists of the later half of the last century. The logical result was that species were mostly regarded merely as arbitrary divisions of the continuous and everchanging series of individuals found in nature. Of course active taxonomists did not overlook the existence of sharply and distinctly delimited species in nature — but as the existence of those distinct units disagreed with the prevailing theories, it was mentioned as little as possible, and anyhow it did not much influence the general discussion of the species-problem. Important exceptions were formed by the works of Wagner, Gulick and Romanes (comp. below pp. 393—394) as well as by Dollo) 1893), Bateson (1894) and some other authors. But first the rediscovery of the Mendelian laws (1900) and de Vries' mutation-theory (1901) brought the principle of discontinuity to its full right again in the genetical discussion.

The vagueness of the traditional species-concept has got a very significant expression in the international rules of botanical nomenclature adopted by the international botanical congresses of Vienna 1905 and Brussels 1910. In those rules, no serious attempt at all was made to define the species-concept. The extremely vague formulation of the articles dealing with the fundamental taxonomical units is clearly shown by the following abstracts:

»Art. 10. Every individual plant belongs to a species (*species*), every species to a genus (*genus*), every genus to a family (*familia*), every family to an order (*ordo*), every order to a class (*classis*), every class to a division (*divisio*).

Art. 11. In many species we distinguish varieties (*varietas*) and forms (*forma*), in the case of parasites special forms (*forma specialis*); and in some cultivated species, modifications still more numerous; in many genera sections (*sectio*), in many families tribes (*tribus*).

Art. 12. Finally if circumstances require us to distinguish a greater number of intermediate groups, it is easy, by putting the syllable *sub* before the name of a group, to form subdivisions of that group. In this way subfamily (*subfamilia*) designates a group between a family and a tribe, subtribe (*subtribus*) a group between a tribe and a genus, etc. The arrangement of subordinate groups may thus be carried, for wild plants only, to twenty-two degrees, in the following order: Regnum vegetabile. Divisio. Subdivisio. Classis. Subclassis. Ordo. Subordo. Familia. Subfamilia. Tribus. Subtribus. Genus. Subgenus. Sectio. Subsectio. Species. Subspecies. Varietas. Subvarietas. Forma. Forma specialis. Individuum.

If this list of groups is insufficient it can be augmented by the intercalation of supplementary groups, so long as these do not introduce confusion or error.

Example: *Series* and *Subseries* are groups which can be intercalated between subsection and species.

Art. 13. The definition of each of these names of groups varies, up to a certain point, according to individual opinion and the state of the science, but their relative order, sanctioned by custom may not be altered. No classification is admissible which contains such alterations.

Examples of inadmissible alterations are, — a form divided into varieties, a species containing genera, a genus containing families or tribes.

Art. 14. The fertilization of one species by another gives rise to a hybrid (*hybrida*); that of a modification or subdivision of a species by another modification of the same species gives rise to a half-breed (*mistus, mule* of florists).» (Briquet 1912 p. 33.)

This vague conception of the fundamental units is still found in most taxonomical works (comp. Diels 1921 and Hitchcock 1925). The differences in »individual opinion» mentioned in the rules are constantly leading to divergences between different workers regarding the right use of the various terms, the same unit being treated as a species by one author, as a subspecies by another one, as a variety by a third one, as a form by a fourth one, etc. And certainly there is little hope to attain a better stability in this respect, as long as no better definitions than those of the international rules have become generally accepted. Probably most taxonomists think that just t h e i r way of using the terms concerned should be considered the right one — but why, probably very few of them would be able to tell. The situation has grown still worse through the suggestion of various geneticists to replace the old terms of taxomomy with a lot of new ones better defined. And certainly it is no exaggeration to say, that the attaining of a stable and generally accepted system of well defined terms for the designation of the various fundamental units is one of the most urgent needs in present taxonomy.

The following attempt to a critical revision of the fundamental units of taxonomy is founded upon a synthesis of about 20 years active taxonomical field- (and museum-) work — mainly in lichens, marine algae and vascular plants — with an extensive study of taxonomical and genetical literature with a bearing upon this problem. For many years I have occupied myself with the general problems of taxonomical methodology (comp. Du Rietz 1921 pp. 10—13, 1923 *a* pp. 235—241, 1924 *a* pp. 385—391, *b* p. 76, 1930 pp. 294—296). However, it is a great pleasure for me to acknowledge the most stimulating impulses I received during my recent sojourn in New Zealand (1926—1927) from many discussions and excursions with Dr. L. Cockayne and Dr. H. H. Allan, whose recent work on those problems could not fail to attract my intense interest. As I am going to take a good deal of the examples used in the following discussion from the flora of New Zealand, I also wish to use this opportunity to express my deep gratitude to the New Zealand Government and to all my New Zealand botanical

friends — the names of which it is impossible to enumerate here — for the neverfailing interest they took in my efforts to learn to know as much as possible of the flora and vegetation of their wonderful country. — During most of the New Zealand fieldstudies referred to below my wife, Mrs. Greta Du Rietz, was an invaluable collaborator.

2. The taxonomical units as concrete populations.

For many years there has been much discussion among biologists regarding the concrete or abstract nature of the various units of taxonomy. A very good summary was given in 1914 by Plate (pp. 115—118). Many biologists have completely denied the existence of any concrete units in taxonomy except the individuals, while others have considered a l l taxonomical units as concrete. Between those two extremes there are numerous intermediate gradations. A rather common compromise accepted also by Plate is the view that only s p e c i e s are concrete units, while all the higher units are abstract. And many modern geneticists have insisted upon the b i o t y p e s being the only concrete units existing in nature.

The following words by Plate probably express a rather common view among those present day biologists, who have taken the trouble of thinking about those problems (comp. also Klingstedt 1928).

»Die Worte Art, Gattung, Familie usf. haben einen doppelten Sinn; sie bezeichnen einmal B e g r i f f e v o n G r u p p e n und sind als solche wie alle Begriffe abstrakt; sie bezeichnen aber auch die realen Objekte, welche diesen Begriffen zugrunde liegen, also I n d i v i d u e n k o m p l e x e, und solche Komplexe sind natürlich ebenso real, wie die Individuen, aus denen sie sich zusammensetzen. Diese Individuenkomplexe sind voneinander insofern verschieden, als derjenige Individuenkomplex einer Art völlig unabhängig ist von der menschlichen Analyse und daher objektiv in der Natur existiert, während die übergeordneten Individuengruppen (Gattung, Familie usf.) nicht durch sich selbst, sondern nur durch den vergleichenden und überlegenden Verstand des Menschen gebildet werden. In diesem Sinne ist die Art etwas Reales, während die Gattung, die Familie, überhaupt die höheren Gruppen abstrakter Natur sind.« (Plate 1914 p. 118.)

In modern genetical literature species and their subordinate units are often spoken of as p o p u l a t i o n s (= Plate's »Individuengruppen«) — certainly a very sound and stimulating method of treatment. In a previous paper (Du Rietz 1930 pp. 293—296) I have proposed to apply the population-concept to all sorts of taxonomical and plantsociological units, a course that I am going to take also in the following discussion. Thus I am going to treat a l l the various units of taxonomy discussed below simply as concrete populations, leaving the discussion of the possibly abstract nature of the c o n c e p t s aside to those biologists more interested in formal logic than myself. Far more important than those purely theoretical discussions is, according to my opinion, the problem of the definite or arbitrary nature of the borderlines between the populations accepted as units (Du Rietz 1923 *a*). But of course even a most arbitrary delimitation cannot take away the concrete nature of the population we are dealing with (comp. Hall and Clements 1923 p. 9). Nor may we forget the g e n e a l o g i c a l c o n t i n u i t y of a species as is often done by authors advocating a purely abstract species-concept (comp. Klingstedt 1928).

3. **The individual.**

The most elementary unit of taxonomy is the individual. The limits of an individual are not always easy to define, but I think most biologists of the present day agree that the soundest definition is the physiological one, *i. e.* that the main criterion of an individual should be its physiological autonomy. Thus in cases of vegetative propagation a new individual is formed with the break of the connection with the mother-plant. Theoretical and practical complications arise in several cases, especially in the case of vegetative segregation and in colonies of closely connected individuals. I think, however, that we may leave those cases aside in the following discussion. After the introduction of the clone-concept (comp. below) certainly nobody will share the opinion of Gallesio (1816) and Huxley (1855), that every clone should be considered o n e individual, a view rather widespread among earlier authors. As to the various individual-concepts of classical morphology compare Haeckel 1866 pp. 241—374.

4. The clone.

A clone (Webber 1903, Shull 1912 *a* and *b*, Johannsen 1913) is a population consisting of the vegetative (asexual) descendants of one individual.

There has been some doubt whether a clone must consist only of genotypically identical individuals or if also individuals formed by vegetative segregation (»bud-mutation» etc.) may be included in it. Shull (1912 *a* pp. 28—29) primarily adopted the first view, but later on (1912 *b* p. 183) went over to the second one, making his clone-concept a »purely genealogical» one. Johannsen (1913 pp. 200 and 209) joined the latter view, which appears to be the prevailing one among modern geneticists (comp. Winge 1928 p. 50). Practically, the matter is of minor importance, but obviously this clone-concept is useless as a taxonomical unit. In order to avoid confusion and uncertainty, it may be recommended to use the term »pure clone», when dealing with clones as taxonomical units, *i. e.* when genotypical homogeneity is postulated.

A special type of clones of great importance for taxonomy is the apomictic one, formed by apomictic propagation of one individual.

The investigations of modern geneticists have clearly proved that the various individuals of a clone are genotypically identical (vegetative »mutations» excepted). Thus a clone apparently is a taxonomical unit of extreme homogeneity. At least many of the species of *Taraxacum* and of *Hieracium* subgenus *Archieracium* described by Scandinavian taxonomists probably are pure clones (comp. below pp. 358 and 362).

5. The pure line.

A pure line (Johannsen 1903) is a population consisting of the individuals formed by strictly autogamous reproduction of one homozygotic individual.

There has been some doubt wether only populations formed by autogamous reproduction of one homozygotic individual should be called pure lines, or if that concept may be extended also to populations including heterozygotic individuals (Lehmann 1914 pp. 286—287). However, it appears quite clear that the term »pure

line» must be maintained in the sense of JOHANNSEN — if not, we would have to invent a new term for the concept of JOHANNSEN, as we certainly cannot do without it. On the other hand, it appears that we have little need of LEHMANN's extended »pure line»-concept. Practically, the matter is of little importance, as strictly autogamous reproduction within few generations leads to (at least practical) homozygosity (JENNINGS 1912 p. 487 etc., JOHANNSEN 1913 pp. 484—485, 496—499, comp. also for instance NILSSON-EHLE 1915 p. 35, LOTSY 1916 pp. 68—75, BAUR 1919 pp. 311—312, HAGEDOORN 1921 pp. 115—118).

As JOHANNSEN (1903, 1913 etc.) and others have shown, a pure line is a unit of the same homogeneity as a clone, *i. e.* all individuals of one pure line are genotypically identical, provided that no »mutation» takes place within it. However, the pure line-concept of JOHANNSEN is a purely genealogical concept, *i. e.* if a mutation takes place, the descendants of the genotypically deviating individual arisen through this mutation are included in the same pure line, which thus loses its genotypical homogeneity (comp. JOHANNSEN 1913 pp. 209—210, SHULL 1912 *a* pp. 28—29). As a taxonomical unit, the pure line thus is as useless as the clone. For taxonomical use, a concept corresponding to that of the »pure clone» would be necessary, *i. e.* a concept including only pure lines of genotypical homogeneity. In the following discussion I am going to designate this concept by the term »pure line *sensu stricto*» (or »pure line *s. str.*»).

Good examples of pure lines of apparent taxonomical value are furnished by the »petites espèces» of *Erophila* described by A. JORDAN (1864, 1873) and ROSEN (1889, 1910, 1911, 1925, comp. WINGE 1926 *a*[1]). However, as absolute autogamy appears to be at least extremely rare in nature (comp. LOTSY 1916 pp. 77—78), the taxonomic value of pure lines appears to be rather restricted. At least in most pure lines a cross with another one sooner or later will happen, giving rise to a lot of new pure lines and thus increasing their number so much that their recognition as taxonomical units will be a rather hopeless task — especially if many of those pure lines are phenotypically overlapping and practically indistinguishable from each other (SHULL 1929 *b*).

[1] According to LOTSY (1926), some of those may be apomictic clones, in spite of WINGE's criticism of BANNIER's (1923) attempt to prove the existence of apomixis in *Erophila*.

6. The biotype.

A biotype (Johannsen 1909) is a population consisting of individuals with identical genotypical constitution.[1]

The term biotype, now in general use, was not immediately generally accepted by geneticists, some of them preferring for a long time to use Johannsen's term »genotype» also in this sense (comp. for instance Lotsy 1916, Schmidt 1917, Heribert-Nilsson 1918). In some previous works (Du Rietz 1921, 1923 *a*) I followed those authors, while my present treatment of all taxonomical units as concrete populations of course makes the accepting of Johannsen's distinction between »genotype» and »biotype» quite necessary. (Comp. also Jennings 1911 and Shull 1912 *a*.)

As every pure clone and every pure line *s. str.* consists of one biotype, the biotype in exclusively vegetatively propagating or strictly autogamous populations is a unit of apparent importance for taxonomy. In strictly allogamous populations without vegetative reproduction, however, there is little chance that any biotype is represented by more than one individual (at least at the same time), on account of the very great number of possible combinations of genes. This has been pointed out by many authors (comp. for instance Lehmann 1914 p. 291, Lotsy 1925 *a* p. 29); a good example is furnished by the human population. In those cases the biotypes are apparently of little taxonomical importance, as biotype and individual will become practically synomymous. Intermediate cases are found in populations with both vegetative and allogamous or with both autogamous and allogamous propagation.

A biotype may be either homozygous or heterozygous.

According to our present knowledge, there is probably not much chance to find completely homozygous biotypes in other populations than strictly autogamous ones (Johannsen 1913 p. 627). This means that the only really homozygous biotypes existing will be those forming pure lines — and even the homozygosity of those is now seriously doubted by Lotsy, probably with full right (Lotsy 1925 *a* p. 27). In a series of papers published in the

[1] In his earlier works (1905) Johannsen used the Danish equivalent of »biotype» (»livstype») as a synomym for both his later terms »genotype» and »biotype». The form »biotype» was first used in 1906 (comp. Shull 1912 *a* p. 27).

years 1912—1916, however, LOTSY claimed that the homozygous biotypes were the real fundamental units of taxonomy, and therefore the only units worthy of being called species. Theoretically, it was not LOTSY's intention to make his new species-concept synonymous with JOHANNSEN's pure line (*s. str.*), as he at that time apparently expected absolute homozygotes to occur also in allogamous populations[1]. He vigorously defended himself against the accusal of LEHMANN (1913, 1914 *a*, *b*) of having proposed a restriction of the term »species» only to the pure lines (LOTSY 1914 *b* pp. 614—616) and clearly declared, that »keineswegs alle Arten reine Linien sind». Nevertheless, it has become a habit among geneticists to polemize against the absurd proposition of LOTSY to call only pure lines species — without mentioning anything about LOTSY's first supposition that species in his sense were common also in allogamous populations (HERIBERT-NILSSON 1918 pp. 136—137, HAGEDOORN 1921 p. 190, TURESSON 1929 *a* pp. 325 and 332). Certainly this is not quite fair, as a good deal of the absurdity in LOTSY's theoretical species-concept is constructed by those authors themselves. Practically, they probably are quite right in their belief that species in LOTSY's sense will be formed only in pure lines. But in order to give a clear view of LOTSY's species-concept it is absolutely necessary to point out that its founder expected it to be generally applicable both in autogamous and allogamous populations. And even if this supposition may look absurd in the light of our present knowledge, we must not forget that it may have been a different matter in 1912—1916.

In his polemics against LOTSY, LEHMANN (1914 *b*), who wanted to retain the term species in its old sense, proposed the term »isogene Einheit» as a designation for LOTSY's »species». But the ambiguity of that term appears to have been felt by LEHMANN himself, for in one place (1914 *b* p. 291) he replaces it with »das Isogenhomozygotische». Nevertheless LEHMANN's term »isogene Einheit» has been accepted by LOTSY (1920 p. 181) as a substitute to his »species», the latter term being completely avoided in LOTSY's more recent papers. Another synonym for the same concept is RAUNKIAER'S »genospecies» (RAUNKIAER 1913, 1918). For our present need, no other term for that concept than »homozygous biotype» appears to be necessary.

[1] Later on, LOTSY gave up this belief and went over to the extreme contrary, namely to the doubting of the existence of any absolutely homozygotic biotypes in nature (1925 *a* p. 27) even in pure lines.

As a complement to his new species-concept, LOTSY proposed to call all heterozygous biotypes »hybrids» — which meant the introduction of a quite new sense also for this venerable term. Also this proposition must be seen in the light of LOTSY's belief in the common occurrence of homozygous biotypes (species *sensu* LOTSY) also in allogamous populations. Certainly it was not LOTSY's intention to propose to call every biotype in an allogamous population a hybrid — as has turned out to be the practical consequence of his hybrid definition. Also RAUNKIAER (1918) applied the same hybrid- (or »bastard»-) concept.

It is of great importance for the right understanding of much of the recent literature on species and hybrids to keep in mind the real origin of LOTSY's new application of the terms »species» and »hybrid». That LOTSY's species-concept was radically different from the traditional one, has been realized by all authors. That just the same thing must be said of his hybrid-concept, has apparently been overlooked by many.

Theoretically, two or more biotypes may be morphologically absolutely alike but still have different genotypical constitutions, possible to reveal only by genetical analysis. Such biotypes would form an isoreagent in the sense of RAUNKIAER (1918). According to RAUNKIAER, the isoreagent is »die letzte Einheit der Systematik». The practical need of this concept, however, appears rather doubtful. In strictly allogamous populations, as mentioned above, there is little chance for any biotype to be represented by more than one individual (or one clone). Probably the chance that two individuals belong to biotypes with absolutely identical morphological appearance is not much greater. Anyhow, what we know about the human population does not give much hope to find two such individuals.

7. **The form.**

A form (*forma*) is a population of one or several biotypes occuring sporadically in a species-population (not forming distinct regional or local facies of it) and differing from the other biotypes of this species-population in one or several distinct characters.

The term »form» has been used by taxonomists in so many different senses, that the possibility of uniting taxonomists in the use of that term proposed above appears rather doubtful. If this proposition should fail to become generally accepted, the best thing to do will certainly be to abandon the term »form» altogether (except perhaps in a very general sense, as proposed by Cockayne 1928 p. 7, 1929 p. 23). But it would not be easy to find a better term for the concept concerned — nor to get this new term universally accepted. The term »aberration», now frequently used by zoologists about in the same sense (Semenov-Tian-Shansky 1910, Dobrzansky 1924, Rensch 1929), is used by Winge (1928 p. 243) and other modern geneticists (*e. g.* Clausen 1927 p. 253) for a quite different concept (chromosome-mutation). Another newly established synonyme is »exotypus» (Remane 1928, comp. Rensch 1929 p. 10). Very often also the term »variety» has been used in this sense.

In many taxonomical works (comp. for instance Engler 1916 p. 4) we find the term »form» used for the designation of what is now generally called »modification» (Nägeli 1865 pp. 277—278, 1884 p. 264, Lotsy 1916 p. 28, Baur 1919 p. 9, Diels 1921 p. 175) or »epharmone» by Cockayne and Allan (1927 p. 263, comp. also Cockayne 1928 p. 7, 1929 p. 22), *i. e.* units of purely p h e n o t y p i c a l nature. For this concept, however, the term m o d i f i c a t i o n appears to be so well established in the literature of the present day, that we certainly do best in sticking to it. That I am not giving the modification a place among the »fundamental units of taxonomy», is due to my strong conviction of the absolute futility of describing and naming modifications in taxonomical works. If we describe and name one modification, we could equally well describe and name thousands or millions of them. Of course exact studies of the phenotypical variability of biotypes may have their given place in botanical science — but such studies should certainly be made in a way quite different from that of describing and naming modifications as taxonomical units.

According to the definition of the form given above, it would be theoretically possible to describe every morphologically distinguishable biotype of a species as a form. If we keep in mind the little chance of any biotype being represented by more than one individual (or clone) in allogamous populations, the futility of this task is easily seen. The describing and naming of single

biotypes within a species can certainly only be taken into consideration when one biotype is represented by a great number of individuals, as is the case in clones and pure lines.

In allogamous populations with vegetative propagation leading only to the formation of small clones it is obviously equally futile to describe and name each of those clones as it would be to describe each individual in an allogamous population without vegetative propagation. The formation of such small clones is a very common process in nature. An easily observed example is that furnished by the *Anemone nemorosa*-population around Upsala, in which a careful observation everywhere reveals clones one or a few square meter large, and distinctly differing from each other in colour (some are anthocyaninic and some are not), the form and size of the sepals, etc.

If sexual reproduction remains unchecked, there will be little hope for such clones to develop to larger monobiotypic populations worthy of special descriptions and names. But if the clone-forming biotype has lost its power of sexual reproduction completely or partly, the clone will easily develop into a monobiotypic population of sufficient size to be recognized by taxonomists. If the power of sexual reproduction is only partially lost, as in the cases of facultative apomixis described in *Hieracium* subgenus *Pilosella* (Ostenfeld 1910, 1912, 1919, Rosenberg 1917, comp. also Täckholm 1922 pp. 313, 352—353), the apomictic clones may become large enough to be distinguishable as distinct forms, but between those clones crossing takes place often enough to make it impossible to treat them as separate species. Quite different is the case if the power of sexual reproduction is completely lost. In this case many clones may develop into sharply delimited monobiotypic populations large, constant, and permanent enough to be easily recognized by taxonomists as distinct species, each with its characteristic distribution-area. The best known examples of such populations are furnished by apomictic species in the section *Vulgata* of *Hieracium* subgenus *Archieracium* (comp. below pp. 358 and 362).

However, it also happens that a clone completely lacking the power of sexual reproduction lacks the vitality needed for growing out into a population large, constant, and permanent enough to be treated as a new species. Good examples of such clones are furnished by lichens. Of many lichen-species normally pro-

ducing apothecia but no soredia there are found soredia-producing forms without apothecia, occuring sporadically as very small isolated clones in the great population formed by the species concerned, and obviously of slight vitality and ephemeral appearance, as larger clones are never found. In a previous paper (Du Rietz 1924 *a* pp. 386—388) I have described several such clones (or groups of near related clones) as varieties, while similar clones (or groups of clones) of somewhat larger size and apparently of somewhat greater vitality were described as subspecies (l. c. pp. 388—389). With the terminology proposed in this paper, both types of clones must be called forms only. As will be shown further below, there are also found soredious clones with great vitality and large continuous distribution-areas, having the typical appearance of species and being separated by taxonomists as such.

Analogous to the clones with retained power of sexual reproduction are probably most of the pure lines occuring in wild plant-populations. As absolutely pure autogamy is hardly found in nature, there is little chance for any pure line to grow out into a real species, but very often it may grow out unspoilt by crossing into a population large and distinct enough to be distinguished as a good form. Good examples of such pure lines easily distinguishable in nature are the »petite espèces» of *Erophila* mentioned above (p. 339). Several of those pure lines are often found together; crossing is apparently rare in nature but easily performed artificially, resulting in a large number of new biotypes (Rosen l. c.).

Such distinct monobiotypic forms as mentioned above from autogamous or asexual populations are lacking completely in typically allogamous populations. If we want to divide such populations into forms, we will have to deal with polybiotypic forms, *i. e.* with groups of biotypes kept together by certain characters lacking in other groups. Such polybiotypic forms have no genealogic continuity; they simply consist of a lot of similar biotypes arising independently of each other in the everchanging stream of intercrossing biotypes, and disappearing again when crossed with biotypes belonging to other forms of the same populations (if not disappearing because of lacking vitality or sterility, as is often the case in the most aberrant forms of a species-population). Thus the polybiotypic form can scarcely be said to be a natural unit, being far more an artificial

means of studying the polymorphy of a given species-population. We should not forget that when choosing a system for naming and describing polybiotypic forms.

In many cases we only want to keep apart the most aberrant forms of a species-population, leaving the rest of the population undifferentiated under the name of »the main form», »f. *typica*», or similar designations. Thus we often want to note the occurrence of sporadic white-flowering forms in a species with normally coloured flowers, or of forms with laciniate leaves in species with normally entire leaves. Such forms are now often described and named in the same manner as species and other units of higher rank, *i. e.* they are given an arbitrarily chosen Latin name and a short Latin diagnosis. Certainly this is a very unpractical method. Much better is the (also common) method of naming all white-flowering forms of normally coloured-flowering species »*forma floribus albidis*» (»*f. flor. alb.*»), *i. e.* of choosing a stereotyped formula for all the analogous forms of different species. That this method is practically applicable, is due to the remarkable parallelism in polymorphy found in the most different species of the same class of the vegetable system, and often quoted in modern literature as »Vavilov's law of homologous variation» (Vavilov 1922, comp. also Baur 1919 pp. 293—294, Du Rietz 1921 p. 13, Philiptschenko 1926 pp. 63—81, Seybold 1927, Troll 1928 pp. 90—91, Hall 1928 p. 8). Also for the naming of teratological forms this method appears very suitable.

This method, which really implies a naming of the characters of the forms rather than of the forms themselves, certainly is much in advance of the ordinary practice of taxonomists, *i. e.* that of naming each form by an arbitrarily chosen name, difficult to invent and difficult to remember, and describing it with a diagnosis (a good system of character-naming, of course, makes any description superfluous). It is equally applicable when we want more than distinguishing the most aberrant forms, *i. e.* when we want to divide the whole species-population into forms suitable for helping us to study the polymorphy of that population. In the taxonomy of *Sphagnum,* this method was proposed already by Russow (1888), and is now commonly used by sphagnologists. Certainly it has done much for simplifying the taxonomy of this polymorphic genus. However, a good part of the *Sphagnum*-forms designated in this way may be mere modifications.

In most cases, however, it will prove necessary for the intensive study of the polymorphy of species-populations to invent a special system for the division of the species-population concerned into suitable forms and for the naming of those forms. Good examples for such practical systems are furnished by H. E. Petersen's studies of the polymorphy in the species *Anthriscus silvestris* (1914, 1922) and *Pimpinella saxifraga* (1921), and also by Crampton's monographs of the land-snail genus *Partula* in the Society and Mariana Islands (1917, 1925 *a*, *b*). In *Anthriscus silvestris*, Petersen distinguished 16 »main groups of forms» marked by Latin names (*Brevisecunda, Latior Brevidivisa, Latadivisa* etc.), the distribution of which was studied statistically; in each group he distinguished and named a number of »forms» (*Brevisecunda media, Brevisecunda Longibrevis media,* etc.). In a similar way, Crampton divided his species of *Partula* into a number of »color-classes»[1] (sometimes those were grouped to »color-orders»), which were used as units for the statistical studies of the regional variability of the polymorphy of the species. In many cases it may prove practical not to give the forms any names at all, but simply divide the population into variation-classes marked by numbers (Sirks and Bijhower 1919, Petersen 1924, 1926), or by letters symbolizing the main characters, as was done already by Coutagne 1895 in his studies of polymorphic mollusca (comp. Bateson 1913 p. 126) as well as by Raunkiaer (1925) in his study of the polymorphy of a Danish *Crataegus*-population. It may also often be practical to study the polymorphy of the different organs separately, using a »dynamic system» in the sense of Hayata (1921 *a*, *b*, 1928 *b*, *c*, comp. below p. 409). The species *Picea excelsa*, for instance, is often divided into one series of forms according to the form of the cone-scales and other series of forms according to the ramification, the needles etc. (comp. Sylvén 1916 *a* pp. 112—152).

In practical taxonomy, such intense analyses of the polymorphy within a species-population as mentioned above is mostly out of question, the average taxonomist having to be content with distinguishing the most conspicuous forms within each species. As a matter of fact, even those most conspicuous forms of a species are often completely neglected by taxonomists, as long as they are regularly occurring together, thus being normal characteristics

[1] Analogous to the »color-patterns» or »elementary patterns» distinguished by Pilsbry and Cooke (1912—1914) in Hawaiian *Achatinellidae*.

of every part of the species-population concerned. Very few taxonomists, for instance, take the trouble of distinguishing and naming the two colour-forms of *Orchis sambucina* (in the floristic handbooks those are only rarely mentioned as f. *typica* and f. *purpurea*) — it is simply considered characteristic for the species that both those forms are regularly found together. More or less analogous cases are offered by anthocyaninic and non-anthocyaninic forms of many other species: sometimes they are named by taxonomists, sometimes not. Analogous forms differing in the shape of the leaves, in the villosity etc. are, as a rule, estimated somewhat higher, and are mostly mentioned in the floristic handbooks as f. *latifolia* and f. *angustifolia*, f. *glabra* and f. *villosa*, etc. But only if the forms concerned show marked differences in their distribution, *i. e.* tend to the formation of more or less pure populations, they attract the interest of taxonomists in a more profound way. In this case, however, they approach the next stage in the series of taxonomical units, namely the variety.

As the near relation between two morphologically distinct forms of one species-population may be very difficult to recognize except by a close field-study of the living population, various forms of the same species (and even of the same variety) have often been described as separate species in traditional museum-taxonomy. Good examples are furnished by many of Gulick's species of Hawaiian *Achatinellidae*, shown by Pilsbry and Cooke to be mere forms of the same species. And if the two colour-forms of *Orchis sambucina* had been growing in an exotic country without local botanists and sent to a European museum in dry herbarium-specimens (or even in living specimens to a botanical garden), they would probably have been described as two good species. The danger of mistaking forms for taxonomic units of higher rank may be avoided only by fieldstudies of the population concerned, or to some extent by very large and properly labelled collections demonstrating the polymorphy in each locality.

8. **The variety.**

A variety (*varietas*) is a population of one or several biotypes, forming a more or less distinct local facies of a species.

With the variety we have reached the lowest unit in the series of taxonomical units forming more or less closed intercrossing populations or s y n g a m e o n s (Lotsy 1918, 1919 *a*, *b*, 1921, Danser 1924). While the various forms of an (allogamous) variety constantly cross with each other, thus presenting a more or less ephemeral appearance, the variety itself is subject to crossing with other varieties only in the transition-zones to them.

The occurrence of more or less distinct local facies of a species-population (»local races») is a fact wellknown to biologists since long ago. Many of the »petites espèces» of A. Jordan and his followers were such local races, while others probably were mere forms in the sense defined above. However, it was first by the intense study of the polymorphy of animal species-populations started towards the end of the last century, that the differentiation of species into local races became more intimately known. Thus Gulick (1872—1905), Coutagne (1895), and Mayer (1902) demonstrated the marvellous local differentiation in Mollusca, while Heincke (1898) described »Familien oder Stämme» of the herring, regarded by him as forming »die erste Gruppe des natürlichen Systems und der notwendige Ausgangspunkt aller Untersuchungen über 'die Entstehung der Arten'». In 1910, Semenov-Tian-Shansky proposed the term »natio» for such »besonders kleine lokal-geographische Einheiten» within a species. Somewhat later Lloyd (1912) described a most remarkable local differentiation of Indian rats, the rat-population of each house forming a more or less distinct local facies of the species — a result later confirmed by Hagedoorn (1921) for other countries. In a series of important papers, Sumner (1915, 1917, 1918, 1920, 1923, 1924) demonstrated the differentiation of the California deer-mouse (*Peromyscus maniculatus*) not only in the main geographical races called subspecies but also in a large number of genotypically fixed local races. J. Schmidt (1917) probably was the first author to apply the concepts and terms of modern genetics upon such local races, showing that each local race of the fish-species *Zoarces viviparus* consisted of a great number of intercrossing biotypes, »the average characters of the races in first line being only the statistical expression for a different mixture of various genotypes[1]» (p. 334). Schmidt also pointed out (p. 333), that if his interpretation of his *Zoarces*-ana-

[1] = biotypes (comp. above p. 340).

lyses was right, »there can hardly be any doubt that what has been found for *Zoarces* has a general validity for all populations of all fish-species etc.» Analogous results were obtained by Crampton (1917, 1925 *a, b*) in his studies of Pacific *Partula*-species, each »colony» (= variety in our sense) consisting of a great number of »color-classes» in proportions differing from those of all other colonies. — A similar differentiation of a plant-species into local populations widely differing from each other in the percentage of the various »groups of forms» composing the species was shown in 1914 by H. E. Petersen (comp. also Petersen 1922) for *Anthriscus silvestris*. Some years later, analogous results were obtained by Turesson (1922) in his study of the local races of *Hieracium umbellatum* differentiated in various parts of the coast of Skåne in South Sweden.

The works mentioned above are only some of the main ones in this field of study. The differentiation of species into local facies, each containing a great number of intercrossing biotypes, has now been demonstrated by so many authors (especially zoologists, comp. besides those mentioned above especially Goldschmidt, Seiler and Poppelbaum 1920), that there is little reason to doubt that a closer investigation will reveal a similar local differentiation in most sexual species of both plants and animals.

As to the terminology of those local races, the term »natio» (Semenov-Tian-Shansky 1910) has been used by several zoologists, especially in Russia. It has the great advantage of never having been used in any other sense, but appears to be too little known to have much hope to become generally accepted. The term »jordanon», proposed by Lotsy in 1916, according to Lotsy's original definition (1916 p. 27) would be about synonymous with Raunkiaers »isoreagent» (comp. above p. 342), but, on the other hand, it was explicitly proposed by Lotsy »to replace the term species in the Jordanian sense, viz.: mikrospecies, elementary species etc.» It is not quite clear from Lotsy's own works in what sense the term »jordanon» is practically used by its originator, but probably it may be considered as about synonymous with our »form». By Cockayne and Allan (1927, comp. also Cockayne 1928, 1929) the term »jordanon» is used both synonymous to our »form» and to our »variety». Philiptschenko (1927), on the other hand, proposes to use »jordanon» for all units intermediate between the biotype and the »Linneon» (= the species), and

suggests to distinguish between »Jordanon I Ordnung» (= our subspecies) and »Jordanon II Ordnung» (= our variety). Thus the term »jordanon», in spite of its youth, has already been used in quite as many different senses as the old term »variety» has, and cannot be given any preference from that point of view.

As mentioned above, the term »variety» has been used very often simply as a synonym to our »form». It has also been used to designate a superior unit of the same character, *i. e.* a more collective form or a group of similar forms. However, we also find it used in taxonomical literature as a designation of a geographically limited part of a species-population. In the system of taxonomical units proposed in 1916 by the grand old man of present-day taxonomy, Adolf Engler, we find the term »form» used to designate mere modifications, and »Subvarietät» about as a synonym to our »form», while three units of a more regional character (geographically limited facies of the species-population) are recognized: 1. »Subspecies». 2. »Varietät» und 3. »Rassenvarietät oder Proles (*var. proles*)». None of the three terms last mentioned is used for units of purely local character, all of them far more corresponding to our »subspecies» — or partly even to our species, as the species-concept of Engler is an extremely wide one.

The term »variety» has thus been used in taxonomy for units of the most different rank, ranging from our forms to our subspecies. I fully realize the boldness of my proposition to restrict that term to a unit of more intermediate rank, namely to the more or less l o c a l facies of a species-population. However, if we want to keep the old term »variety» for any of the units of modern taxonomy, this will probably be the only one possible. If my proposition should fail to become generally accepted, the best way will possibly be to abandon the term »variety» altogether, taking our refuge to Semenov-Tian-Shansky's term »natio» for the unit in question.

As has been pointed out clearly by Hagedoorn (1921 pp. 136—139), distinct varieties in our sense are formed only in species consisting of comparatively stationary individuals. In species consisting of more or less rapidly migrating individuals no distinct varieties are found. The differentiation of varieties must thus be due to a certain amount of i n b r e e d i n g, causing a »reduction of the Total Potential Variability»[1] in the sense of Hagedoorn.

[1] = »the number of genes in respect to which an individual or any group

The inadequacy of the common belief in selection as the main acting force to the differentiation of varieties has been shown in a most suggestive way by HAGEDOORN. To HAGEDOORN we also owe the explanation of the automatic reduction of potential variability or polymorphy that takes place quite independently of any sort of selection in any allogamous population more or less effectively cut off from crossing with populations of a different genotypical constitution. This explanation may be summarized in the following way:

1. In a group of freely crossing organisms, »we can very easily show mathematically that, supposing every mating to result in an equally large number of offspring, and assuming an uninterrupted steady increase in numbers, the potential variability remains undiminished. JENNINGS and PEARL have worked out these calculations very thoroughly. However, how does it work out in reality? Is it possible that there is an automatic reduction of variability in freely crossing populations, of the same nature as the very great reduction in self-fertilized organisms and in inbred series, slower, but still appreciable?

In the first place it is obvious, that the multiplication of any group of organisms cannot proceed indefinitely. A few heterozygotes in a mixture of organisms, of which the majority are homozygous will continue to exist as long as multiplication is unchecked. But, wherever the group is continued from a fraction of the number of individuals, or where a colony is started by a few individuals, the chance of the heterozygotes to be included in the group, or to have heterozygous children included, is proportionate to their frequency. Heterozygotes will produce homozygotes, but not the reverse.

The group of organisms chosen by fate to become the parents of the next generation is usually, but always occasionally, considerably smaller than the number of individuals of their species. Every case in which rare individuals, having genes, not present in the majority, or in which rare individuals being impure for,

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of individuals is not pure, homozygous» (HAGEDOORN 1921 p. 104). For the same concept DANSER (1929 *a, b*) uses the term »potential polymorphy». As the term »polymorphy» is tending to replace »variability» in the literature of the present day as a designation of the »gruppenweise Variabilität» (PHILIPTSCHENKO 1927) of a population (comp. COCKAYNE and ALLAN 1927 p. 239), I am following DANSER in this respect.

or lacking in genes, common property of the majority, happen to be excluded from the number of pro-creating individuals, the total potential variability is lowered.

This, in our opinion, is the most important gain in knowledge which we owe to MENDEL's work, and to the biomechanical interpretation of his work. Reduction of potential variability, in other words purity of species is automatic, and not dependant upon any sort of selection.» (HAGEDOORN 1921 pp. 119—120.)

2. If the population concerned is divided into two parts, and those parts are isolated from each other in absolutely identical habitats, there are very great chances that the reduction of potential polymorphy taking place in those isolated parts of the population leads to different results, as 1) the initial genotypical composition of the two parts is hardly ever absolutely identical, some genes probably being stronger represented in one part than in the other, thus having greater chances to survive and to become homozygous in the first part than in the other, and 2) even if a certain gene is equally represented in both parts, its fate in those parts is largely determined by pure chance, in extreme cases leading to its elimination in one part and its homozygosity in the other. Of course this automatic differentiation may be increased by selection, if the habitats of the two parts differ from each other.

3. Even if no complete isolation occurs within a population, the reduction of potential polymorphy easily leads to different results in different parts of the population, causing a differentiation of the population into subordinate units, if intercrossing between more distant parts of the population is prevented by the stationary habit of the population. But while in cases of complete isolation the differentiation results in units more or less sharply delimited from each other (= species), it results in the latter case only in the formation of more or less intergrading units (= subspecies and varieties).

At last it must not be forgotten that in plant-populations the reduction of potential polymorphy, and thus also the differentiation of varieties, is very often hastened by a certain amount of autogamy, or by the formation of clones.

As to the practical study of varieties, most taxonomists certainly agree that Latin names and diagnoses are of little use for those units. A variety is best named by its locality, and is best described by a statistical survey of the forms constituting it (comp.

above p. 347). Very good examples for the various modern methods of studying varieties are furnished by PETERSEN's monographs of *Anthriscus silvestris* and other Danish plant-species (1914—1926, comp. above p. 347), by CRAMPTON's monographs of Pacific *Partula*-species (1917, 1925 *a, b*) and by E. ANDERSON's (1928) investigation of two North American species of *Iris*.

9. **The subspecies.**

A subspecies is a population of several biotypes forming a more or less distinct regional facies of a species.

Like »variety», the term »subspecies» has been used by taxonomists in most various senses. It has been used for any unit intermediate between form and species, *i. e.* for morphologically distinct groups of forms, for varieties in the sense defined above, for sharply delimited populations considered to be too nearly related to be raised to the rank of good species, for species of somewhat dubious autonomy, or for distinct regional facies (geographical races) of a species. The restriction of the term »subspecies» to the sense last mentioned has been gradually inaugurated during the last four decades, in the first line through the works of WETTSTEIN (1896 *a*, *b*, 1898), K. JORDAN (1905), HARTERT (1910—1923), SEMENOV-TIAN-SHANSKY (1910) etc., and now appears to be generally accepted among zoologists, while botanists are still using the term in a rather chaotic way.

Of other terms in use for the same concept, reference in first line must be made to RENSCH's »geographische Rasse» (RENSCH 1929). As RENSCH restricts the species-concept to the species not differentiated in regional facies, applying the term »Rassenkreis» to all geographically differentiated species (comp. below p. 359), he cannot use the term »subspecies» in our sense. Other synonyms to our »subspecies» are KLEINSCHMIDT's »Form» or »Rasse» (comp. below p. 359) and REICHENOW's (1904) »Konspecies» (comp. PLATE 1914 p. 134). By some authors the term »variety» has been used either synonymous with our »subspecies» (comp. for instance CRAMPTON 1917) or as a designation for subspecies of lower rank (ENGLER 1916, comp. above p. 351).

Special reference must be made to the »ecotypes» described by TURESSON (1922—1929). While in some cases they appear to be

identical with good species generally recognized by taxonomists, most of them may be regarded as subspecies in our sense (comp. Rensch 1929 p. 78). In one of his later papers, Turesson (1925 *b*) also applies the term »subspecies» to some of his earlier ecotypes. Theoretically, however, the ecotype-concept of Turesson appears to be more comparable with the »subspecies oecologica» of Alpatov (1922, 1923, 1924). Alpatov pointed out, that several »subspecies geographicae» (=our subspecies) of a species often contained analogous »subspecies oecologicae», *e. g.* that quite analogous »subspecies oecologicae truncicolae» were found both in the European and in the Japanese subspecies of *Formica rufa*. In the same way, an »oecotypus campestris», »oecotypus arenarius» or »oecotypus salinus» in the sense of Turesson (1925 *a* pp. 224—225) may be differentiated in more than one subspecies of a certain species. If the term »ecotype» could be restricted to such cases, it might be found useful to taxonomy, as it is obviously preferable to Alpatov's term. As a synonym to our »subspecies» it appears to be of no use whatever.

That one form may be found in several subspecies of one species, has been pointed out by several authors (comp. Dobrzansky 1924 p. 417). This means that it is not always possible to tell from an isolated specimen in a collection to which subspecies it belongs, if the locality of the specimen or the range of the subspecies is unknown (comp. Sumner 1923 p. 239). Like varieties, subspecies are best described by a statistical survey of the forms constituting it (comp. Crampton 1917, 1925 *a, b*). But unlike varieties, subspecies are conveniently named by Latin names, either after the pattern »*Pinus silvestris* subsp. *lapponica*» (*Pinus silvestris* **lapponica*) or by a simple trinomial name like »*Pinus silvestris lapponica*». The latter method is generally accepted by present zoologists and by some American botanists (comp. for instance Hall and Clements 1923, Babcock and Hall 1924, Hall 1928); it appears to be practical enough to be accepted also by botanists in other countries.

Unlike the species, subspecies are neither sharply delimited from each other nor connected by transitional populations of the »hybrid»-type (comp. below p. 391). The various subspecies of a species are continuously intergrading into each other, their delimitation thus being infinitely much more arbitrary than that of the species. Still there may be more or less distinct zones with increased change in the composition of a species-population, which

of course must be carefully taken into account at the delimitation of the subspecies.

A multitude of good examples of the differentiation of animal species into subspecies is given by Rensch (1929). Wellknown examples from the vegetable kingdom are the subspecies of *Pinus silvestris* (*lapponica, septentrionalis, borussica, scotica, engadinensis* etc., comp. for instance Schott 1907, Sylvén 1916 *a*, *b*, Cajander 1921), and of *Picea excelsa* (the eastern subspecies of which is often treated as a separate species under the name of *Picea obovata*, but according to Cajander *l. c.* continuously intergrades into the European subspecies). Many alpine plant-species are found as different subspecies in different parts of the European Alps (*e. g. Silene acaulis* and several species of *Saxifraga*, comp. Engler 1916). An analogous differentiation in subspecies is found in many alpine and subalpine plant-species of the Southern Alps of New Zealand, a good example being furnished by *Celmisia petiolata* Hook. f. Of this species, which plays a prominent rôle in a good part of the mountain-chain, I had the opportunity of examining at least three different subspecies in the field (one in the upper Waimakariri region at about lat. 43°, one in the Mount Cook region at about lat. 43° 40′ and one in the Routeburn-Humboldt Mts region at the western end of Lake Wakatipu at about lat. 44° 40′). Each of those subspecies was composed by a large number of forms, the general composition of the population appearing to change gradually from the northernmost subspecies of the Waimakariri region to the southernmost one of the Northern Fiord District, which may or may not be connected with *Celmisia verbascifolia* of the Southern Fiord District by a gradual transition.[1] — In many (but by no means in all)

[1] In the Waimakariri-population (on Hills Peak N. of Arthur's Pass and Mt Misery near Cass, both visited by me in the company of Dr. H. H. Allan), I saw only forms with distinctly petiolate, rednerved and more or less serrulate leaves with rounded base, in the Wakatipu-population (on Bold Peak, Lake Harris Saddle, and the peaks around the latter, visited by me partly in the company of Mssrs G. Simpson and J. S. Thomson) only forms without distinct petiolae, with leaves gradually attenuated at the base, not serrulate, or very indistinctly, and with the nerve either green or red. The Mt Cook-population (on Sealey Range) distinctly kept in the middle between those two extremes, consisting partly of unpetiolate, partly of more or less petiolate forms, with the nerve red or green and more or less indistinct serrulation. Some of the forms in the Wakatipu-population are very much approaching *C. verbascifolia* Hook. f., and have even been referred to this species by Cheeseman and Cockayne (some of my specimens Dr. Cockayne named

New Zealand plant genera the differentiation has led to a large number of sharply delimited alpine and subalpine species with comparatively small distribution areas and no distinct differentiation of subspecies, while the species of the lower belts are more widely distributed and often (but not always) differentiated into a number of continuously intergrading subspecies. The explanation certainly must be sought for in the lack of effective barriers in the lower belts, while in the alpine and subalpine belts a certain amount of isolation is often brought about by broad valleys etc. A good example is furnished by the genus *Hebe*, the most common lowland-species *Hebe salicifolia* being distributed throughout New Zealand but differentiated in several subspecies (comp. Cockayne and Allan 1926 *a* pp. 17—19, 1927 p. 274), while most mountain-species show comparatively small distribution areas and no distinct differentiation of subspecies.

10. The species.

The smallest natural populations permanently separated from each other by a distinct discontinuity in the series of biotypes, are called species.

A species thus is a population consisting either of one strictly asexual and vital biotype, or of

»*C. verbascifolia* var. *pubescens*»). However, what I have seen of the latter species (I studied it in the field on Wilmot Pass and Mt Barber at lat. 45° 30′ together with Mr. W. R. B. Oliver) is constantly more glabrous than the most glabrous individuals that I brought home from the Wakatipu-population. In the Dominion Museum at Wellington, where D. Petrie's large collections are preserved, I saw forms of *C. verbascifolia* closely resembling my own from Wilmot Pass and Mt Barber, collected as far north as in the Clinton Valley (lat. 44°50′), while all the specimens collected further north or further east in the Fiord and South Otago Districts far more resembled those of my Wakatipu-population. Further field-studies must decide whether *C. verbascifolia* and the southern subspecies of *C. petiolata* are connected only by a narrow hybrid-zone (to which then probably some of the forms in my Wakatipu-population should be referred) or by a broad zone of more continuous intergrading. In the latter case it may prove necessary to include *C. petiolata* and *C. verbascifolia* into one heterofacial species. However, it must be pointed out that my knowledge of the populations concerned is far too incomplete to guarantee that not further field-studies will reveal zones of discontinuity even within the huge population here referred to *C. petiolata*, enabling future taxonomists to split it into several species — though what I have seen of it appears to make this rather improbable.

a group of practically undistinguishable, strictly asexual and vital biotypes, or of many sexually propagating biotypes forming a syngameon[1] separated from all others by more or less complete sexual isolation or by comparatively small transitional populations.

One of the greatest difficulties confronting every attempt to give a generally applicable species-definition is formed by the fundamental difference between the constitution of sexual and asexual populations. Owing to this difference, different alternatives for sexual and asexual populations are necessary in the general definition of the species-concept. While there is a comparatively good agreement (at least theoretically) among present-day botanists regarding the species-concept in sexual populations, very different opinions are found regarding what should be called species in asexual populations. Many geneticists find it absurd to call single asexual biotypes or even small groups of practically undistinguishable asexual biotypes species, when most sexual species contain an enormous number of biotypes (comp. for instance Turesson 1922 p. 232, 1923 p. 173, 1926 *b* pp. 187—190, 203, 1929 *a*, Clausen 1922, Tedin 1925 pp. 355—356) — but as yet they have failed to tell what unit in asexual populations should be better corresponding to the sexual species. The definition recently given by Turesson for his new concept »agamospecies» (1929 *a* pp. 332—333: »An apomict-population the constituents of which, for morphological, cytological or other reasons, are to be considered as having common origin») is obviously too vague to be of any practical value at all, as it is equally applicable to any unit of higher rank than the biotypes in the genera concerned (from a group of a few biotypes up to the whole genus!). As K. Johansson (1927) has pointed out for the *Hieracia Vulgata*, it is often a rather hopeless task to group the apomictic »microspecies» to higher units of any taxonomical importance to which the name »species» could be applied. Thus in those cases we simply have to apply the species-concept to the »microspecies», if we wish to use it at all in the genera concerned. The claim of certain geneticists that the species-concept should be applied to units of about the same size and the same polymorphy, will hardly be generally accepted by taxo-

[1] = »intercrossing population». Comp. Lotsy 1918, 1919 *a*, *b*, 1921, Danser 1924 pp. 204—209.

nomists, though the same view is sometimes found also among taxonomists (comp. below). Among most present-day taxonomists the view is firmly established, that a natural species-concept can be founded only upon the principle of discontinuity, *i. e.* that we have to delimit our species simply after the lines or zones of discontinuity found in nature, without any prejudice as to the convenient size of the species. If Nature has made some species larger and more polymorphic than others, we simply have to accept this arrangement.

Far more difficult than the delimitation of species in strictly asexual populations (which in spite of the often very great number of species probably is one of the easiest tasks confronting the taxonomist) is the dealing with facultatively asexual populations. As mentioned above (p. 344) the stability and permanency of the clones in such cases is often hardly sufficient to give them the rank of species, and the species-delimitation in facultatively asexual populations may certainly be a most difficult task (comp. for instance the genera *Rubus* and *Rosa*). Similar difficulties are met with in facultatively autogamous populations (regarding the delimitation of species in those comp. Shull 1923, 1929 *a*, *b*).

As was mentioned above, the acceptance of discontinuity as the only base for the delimitation of species must lead to the rejection of size as a base for that delimitation. There is a rather widespread tendency among present-day biologists (especially among zoologists) to apply the term »species» only to populations of comparatively equal size (comp. for instance Rydberg 1929 and the authors mentioned below). A consequence of this tendency is the method of certain modern zoologists to restrict the use of the term »species» to comparatively homogenous populations not differentiated into distinct geographical facies, substituting it with the term »Rassenkreis» (Rensch 1926, 1929, preceded by the »typus polymorphus» of Engler 1872, 1916, the »Rassenkette» of F. and P. Sarasin 1899, and the »Formenkreis» of Kleinschmidt 1901—1926) when dealing with more heterogenous populations (species in our sense) differentiated in »geographische Rassen» (= our subspecies, comp. above p. 354). Rensch is perfectly right in pointing out that his »Arten», as regards size and polymorphy, are far more corresponding to the »geographische Rassen» than to the »Rassenkreise». But if we accept discontinuity, not size nor polymorphy, as the only base for the delimitation of

species, both RENSCH's »Arten» and his »Rassenkreise» must be included in the same species-concept and carry the name of species.

The rejection of the principle of size and polymorphy as a base for the delimitation of species also implies the rejection of the widespread belief that species should be delimited after »the magnitude of the differences» between the forms concerned.[1] According to the species-concept defined above, two forms may be very different and still belong to the same species, if connected by transitional forms, while two other forms may be much less different and still belong to two different species.

In recent genetical literature we often find the term »species» substituted by »Linnean species» or »Linneon» (the latter term proposed by LOTSY 1916). The necessity or even desirability of those new terms is difficult to realize. LOTSY's invention of the term »Linneon» was made necessary simply by his radical proposition to apply the term »species» in a quite new sense, namely as a designation for homozygous biotypes (comp. above p. 341). The latter proposition was declined by practically all biologists, but nevertheless the new term »Linneon» has been accepted by many. If the term »species» is kept in its old sense, »Linneon» in the sense of LOTSY of course is completely superfluous. — COCKAYNE and ALLAN (1927, comp. also COCKAYNE 1928 p. 7, 1929 p. 23) have proposed to use »Linneon» in a modified sense, *i. e.* for a unit superior to the species, or for two or more closely related species connected by hybrids and confused by earlier taxonomists. Against this use of the term may be advanced not only the confusion easily resulting from the use of the same term in two different senses, but also that it appears to give a somewhat wrong idea of what the species of LINNÆUS really were. Surely many of the species described by LINNÆUS on the base of bad and insufficient herbarium-material from foreign countries were aggregates of several good species in our sense (*i. e.* Linneons in the sense of COCKAYNE and ALLAN) — but in the flora studied by LINNÆUS in the field most of them certainly

[1] As I have myself been accused of having advocated this principle by TURESSON (1925 *a* p. 232), it may be appropriate to point out that TURESSON's accusal is based simply upon a wrong citation of my criticized paper, namely by a translation of »scharf genug abgegrenzt» and »scharf abgesondert» into »sufficiently different».

were just identical with the species of present day taxonomists (or in some cases even with units of still lower rank!). There are also examples of Linnean species (in the true sense, namely species described by Linnæus) that were degraded to forms by later taxonomists and reestablished as species first by the modern monographers of the genera concerned (*e. g. Poa angustifolia*).

Also the terms »ecospecies» and »coenospecies» recently proposed by Turesson (1929 *a*) appear to be easily dispensable. Turesson's »ecospecies» is practically only another synonym for our »species», if the asexual species (and some very dubious sexual species with prevailing autogamy) are excepted. His »coenospecies», which according to the definition should consist of species having »a common origin so far as morphological, cytological or experimental facts indicate such an origin», are examplified partly by the dubious species *Capsella bursa pastoris* and *Erophila verna* (both with prevailing, but not obligate, autogamy), partly by groups of nearly related and frequently hybridizing allogamous species (*Viola tricolor* and *V. arvensis*, *Geum rivale* and *G. urbanum*, *Salix caprea* and *S. viminalis*, comp. also the practical application of the term in the latter sense in the genus *Galeopsis* by Münzing 1930). According to Turesson's definition any taxonomical unit superior to the species may be called a coenospecies. If any new terms are needed for the lowest of those units, I prefer Danser's more definite terms »commiscuum» and »comparium» (comp. below pp. 387 and 398).

The distinction between »simple» and »compound» species recently proposed by Cockayne and Allan (1927) certainly is very useful, though it may well be discussed which species are really worthy of being called »simple». According to Cockayne and Allan (1927 pp. 259—260, comp. also Cockayne 1928 p. 7, 1929 p. 22) a simple species is a species that contains only one »jordanon» (comp. above p. 350), while a compound species is made up of two or more jordanons. But even in the simplest sexual species certainly intensive analyses will reveal a very great number of slightly differing forms, and in strictly allogamous species even every individual probably represents its own biotype (comp. above p. 340). Thus the only strictly simple species existing would be those consisting of a single strictly asexual biotype, while all other species would be more or less compound.

As the species-concept is taken in this paper, it is necessary to distinguish at least four main types of species:

1. **Asexual species** (species consisting of one or several strictly asexual biotypes).
   a. Simple asexual species (species consisting of one strictly asexual biotype). To this type probably many apomictic species of *Hieracium* sect. *Vulgata*, *Taraxacum*, etc., in first line those with very small distribution-areas, must be referred, and possibly also a part of the lichen-species never developing apothecia but constantly propagated by soredia, isidia, or undifferentiated thallus-fragments (comp. above p. 345).
   b. Compound asexual species (species consisting of several, practically indistinguishable, strictly asexual biotypes). To this type belong probably many of the apomictic species of *Alchemilla*, many of the more widely distributed apomictic species of *Taraxacum* and *Hieracium* sect. *Vulgata*, and many of the asexual lichen-species mentioned above.

      As has been pointed out by Samuelsson (1922) and K. Johansson (1927), many of these apomictic species in *Alchemilla, Hieracium, Taraxacum* etc. were recognized by taxonomists long before the discovery of apomixis in the genera concerned. Quite independently of the interesting explanation furnished by the apomixis, they were thus recognized in the field as natural, sharply delimited units analogous with other species. Certainly it would involve a good bit of absurdity, if, following the advise of certain modern geneticists, we would take the discovery of their apomixis as sufficient reason to reduce them to units of lower rank than that previously given to them on the base of unprejudiced field-studies.

2. **Sexual species** (species consisting of a great number of freely intercrossing — or partly autogamous — biotypes).
   a. Homofacial sexual species (»Arten» *sensu* Rensch). Regionally undifferentiated, *i. e.* consisting of only one regional facies (subspecies).
   b. Heterofacial sexual species (»Rassenkreise» *sensu* Rensch). Regionally differentiated, *i. e.* differentiated into several regional facies (subspecies).

      As a close survey will probably reveal local facies (varieties) also in most species of the first of those groups (at least in those with more or less stationary individuals), the term »homofacial» is not quite adequate — but as I have not been able to find out any better term, it may

be used at least provisionally. Many homofacial sexual species give the impression of a »simple species» *sensu* Cockayne and Allan, as they consist of biotypes differing only very slightly from each other. But many would be referred to Cockayne's and Allan's »compound species», obviously containing biotypes differing enough from each other to be easily recognized as different forms. This will be the case even in many highly inbred species with very small distribution-areas. In *Gentiana antipoda*, for instance, endemic in Antipodes Island, one anthocyaninic and one non-anthocyaninic form are easily recognized, (Kirk 1895), and I found just the same in *G. antarctica*, endemic in Campbell Island.

Examples of heterofacial sexual species are given above under the subspecies (pp. 356—357). Of course they all belong to Cockayne's and Allan's type »compound species».

As was mentioned above already in the definition of the species, the limits of sexual species may be of different kinds. While some species are separated from each other by complete sexual isolation, others are connected by (comparatively small) transitional populations of various kinds (hybrids). It appears most convenient to discuss those two kinds of species-limits separately.

I. Species separated from each other by complete sexual isolation.

The limits between such species may be said to form distinct lines of discontinuity in the series of biotypes. They may be formed either by geographical or by merely physiological isolation. In the former case, the species concerned may be perfectly fertile with each other when brought together in an artificial way (comp. Danser 1929 *b* p. 425), or the geographical isolation may be guarded also by physiological isolation, *i. e.* by an inherent unability of the individuals from one species to cross with individuals from the other. In the latter case (*i. e.*, when there is no geographical isolation but only physiological isolation of species growing together in the same area), isolation may be due to any of the following causes. 1. Differences in the breeding (or flowering) season or breeding places (the latter only in animals, comp. Plate 1913 pp. 527—531, Robson 1928 pp. 122—124). 2. Morphological, physiological or — in animals — psychological unability of the individuals of one species to cross with those of the other species (comp. Romanes 1886, 1897, Gulick 1872—1905,

Plate 1913 pp. 531—549, Robson 1928 pp. 122—130). 3. Anyone of the two most severe types of »diplontic sterility» described by Münzing (1930 p. 318), *i. e.*, the dying of the diplont at the zygote or embryo stage, or the incapability of the seedlings of an independent existence.

In cases of purely geographical isolation it is often extremely difficult to decide whether the isolated populations should be treated as separate species or as mere parts of the same species. Here four different cases must be discussed separately.

1. If all the individuals of one population differ both greatly and constantly from those of the others, everybody will agree that the two populations represent different species. Thus everybody who has studied the Gentians of the subantarctic islands of New Zealand will agree that *Gentiana antipoda* of Antipodes Island, *G. antarctica* of Campbell Island, and *G. cerina* of the Auckland Islands (of which *G. concinna* of the same islands probably is only a form, comp. Kirk 1895) are good species, though clearly representing one natural group (series) of vicarious species (»Artenkreis» *sensu* Rensch).

2. If all individuals of one population differ constantly but very slightly from those of the others, many taxonomists will treat the two populations as parts (subspecies or varieties) of one species, while others (and among them myself) will keep them apart as separate species. According to the literature, such a case appears to be represented by the middle-european *Pinus cembra* and the Northeast-European and West-Siberian *Pinus sibirica*, by many authors (and also by myself in a previous paper, comp. Du Rietz 1930 pp. 320—321) treated as mere subspecies or even as varieties of one species. Other cases are commonly found in species isolated in the different islands of one island-group (comp. Rensch 1929 p. 100 etc.) or in the different mountain-massifs of one mountain-chain. A good example is furnished by *Pleurophyllum Hookeri* (Compositae) in the subantarctic islands of New Zealand, by previous authors regarded as one species occurring in identical forms in the various islands, but according to my own observations in the field (in the Auckland and Campbell Islands, supplied with studies of herbarium-material from those islands and Macquarie Island) represented by slightly but probably constantly differing populations (= species) in those three island-groups.

3. If the average composition of one population is distinctly

different from that of the others, but certain biotypes from one population so closely resemble biotypes from the others that they must be referred to the same forms, most taxonomists will probably agree that the populations do n o t represent different species, but mere subspecies of the same one. Theoretically, the opposite opinion would be quite possible to defend, but practically it appears imperative to delimit species in such a way that it is possible to determine any well-developed individual also without knowing its provenance. At present I am not able to demonstrate any botanical example of the case concerned — the average composition has been properly investigated in very few plant-species — but a very good zoological example is afforded by Crampton's (1925 *b*) thorough analysis of the *Partula gibba*-population of the two Mariana-islands Guam and Saipan.

4. If the two populations differ only slightly in average composition, nobody of course would think of treating them as different species or even subspecies, in spite of their isolation from each other.

II. Species connected with each other by transitional hybrid-populations.

In this case the limits between the species may be said to form not lines but z o n e s o f d i s c o n t i n u i t y in the series of biotypes. Those zones may be of several different types.

1. The transitional hybrid-population consists of merely sterile individuals.

This type of transitional hybrid-populations is certainly very common, and very many examples are described in botanical and zoological literature. The sterility may be of many different degrees. In extreme cases, leading over to the two severest types of diplontic sterility mentioned above (p. 364), no reproductive organs at all are formed, though the vegetative development may be quite normal. Examples of this subtype are mentioned by Focke (1881 p. 477: some hybrids of *Rhododendron, Epilobium*, *Cereus* and *Hymenocallis*), Heribert-Nilsson (1918: *Salix viminalis* × *fragilis*), and Münzing (1930 pp. 318—319). To the same subtype possibly belong the following New Zealand *Celmisia*-hybrids, of which I only succeeded to find non-flowering individuals (I do not

know whether they have been found flowering by my New Zealand colleagues, to which they are probably all well-known, though little has been published about them yet): *Celmisia coriacea* × *Lyallii* (mentioned already by Cockayne 1923 and 1925, found by myself in several individuals on Sealey Range in the Mt Cook region and on Bold Peak in the Humboldt Mts[1]), *C. coriacea* × *Petriei* (Bold Peak, only one individual), *C. Lyallii* × *petiolata* (Sealey Range in several individuals), *C. petiolata* × *Petriei* (Lake Harris Saddle, only one individual), and *C. petiolata* × *sessiliflora* (on the ridge S. of Lake Harris Saddle, only two leaf-rosettes). The same may be the case with the remarkable hybrid *Olearia Crosby-Smithiana* × *ilicifolia*, at the time of my New Zealand visit known only in a single and — as far as I know — non-flowering shrub at Wilmot Pass in the Fiord District (discovered by Mr. Leslie Murrill, who brought Mr. W. R. B. Oliver and me some branches during our excursion to Doubtful Sound).

Another subtype is represented by the hybrids in which reproductive organs are developed but more or less defective, either morphologically or only physiologically (comp. Münzing 1930 pp. 314—322). The sterility of many hybrids has been well known since very long ago (comp. Focke 1881 p. 477 and Roberts 1929), and from time to time even the theory has been advanced that a l l true »species hybrids» should be at least more or less sterile. Thus the investigation of the seed-production and of the quality of the pollen has become a well-established method in taxonomy for the testing of supposed hybrids. Abundant examples of sterile hybrids are easily found in botanical (and zoological) literature (comp. for instance Focke 1881, Kerner 1898, de Vries 1903, Münzing 1930, and modern floristical handbooks, especially those of Scandinavian countries). A very interesting account of the hybrids in the section *Lapathum* of the genus *Rumex* is given by Danser (1924); some of those hybrids are completely sterile, while others are nearly sterile, producing only very few germinable seeds (comp. below p. 368). As to the New Zealand flora, I do not know any hybrids of this subtype with certainty (comp. Cockayne 1929 p. 11), but there is little reason to doubt that it is common there too, though not as well known yet as fertile and highly polymorphic hybrids. — As mentioned by Münzing (l. c.),

[1] On Bold Peak my *Celmisia*-studies were made in company with Mssrs G. Simpson and J. S. Thomson.

there are many degrees even of complete sterility in hybrids, from types with the flowers degenerating already in the bud-stage to types with flowers of quite normal appearance, but with no seed-production. In the latter case, according to Münzing, either diplontic or haplontic sterility may be responsible.

Hybrids consisting of perfectly sterile individuals are always fairly homogenous, though some polymorphy may be brought about by intraspecific differences between biotypes involved in the interspecific crosses. They do not, as a rule, play any considerable rôle in nature, and do not considerably disturb the sharp limits of the species concerned.

2. The transitional hybrid-population consists of more or less fertile individuals.

The existence of more or less fertile hybrids has been well known, though often doubted, since the time of Kölreuter (1761, comp. Kerner 1871 pp. 34—35). Focke (1881 p. 477) enumerates quite a lot of genera in which fertile hybrids are more common than sterile ones. The considerable polymorphy of many of those fertile hybrids was also well known (comp. Focke l. c.). Still it is first in recent years that highly polymorphic hybrids have come to their full right in the discussion of the species-problem.

Also in this type of transitional hybrid-populations two subtypes may be distinguished. In the first subtype the transitional hybrid-population is obviously less vital than the two species-populations concerned, while in the second subtype the hybrid-population exhibits a vitality quite comparable with that of those species-populations.

In the first subtype of fertile hybrid-populations, comprising those with a vitality clearly lower than that of the species concerned, the hybrid-population may obscure the limit between the two species only rather slightly, as the hybrid-population will play a rather modest rôle in nature compared with that of the two species-populations, and will not be able to enter into serious competition with them in any habitat. The lack of vitality in the hybrid-population may be due to several causes. Though not completely sterile, the biotypes of the hybrid-population may in many cases exhibit a rather low fertility. Both in those cases and in the cases of full fertility the vitality of the hybrid-individuals may be too low to enable them to compete successfully with the species.

Some boreal examples of hybrids of this subtype may first be mentioned. According to Heribert-Nilsson (1918), the hybrid between *Salix caprea* and *S. viminalis* cannot in spite of its fertility compete with the parent species, owing partly to certation phenomena, and partly to characters lowering the vitality in various ways. Many of the *Salix*-hybrids found in the indigenous vegetation of Sweden obviously belong to the same type. — In the hybrid *Viola arvensis* × *tricolor* according to Clausen (1926) there are no biotypes able to compete successfully with the parent species, neither in experimental plots nor in nature. — Similar cases are found in some of the hybrids of *Rumex* sect. *Lapathum*, *e. g.* in *Rumex aquaticus* × *hydrolapathum* (*R. maximus*, comp. Danser 1924 pp. 186—188). Here fertility is always much lower than in the parent species, and the hybrids have therefore no chance in the competition with those species. — Just the same, according to E. Anderson (1928) is the case in the North American hybrid *Iris versicolor* × *virginica*.

Analogous cases are easily found in the flora of New Zealand. Among the best examples are those provided by the hybrids *Ranunculus Buchananii* × *Lyallii* (*R. Matthewsii* Cheesem., comp. Cockayne 1921 p. 359, 1923 p. 118, 1925 p. 63, 1928 p. 240, Allan 1926 *c* p. 534) and *Ranunculus Buchananii* × *Simpsonii* (comp. Cockayne 1928 pp. 241, 301, 302) both of which I have had excellent opportunities to study in the field in the upper Routeburn Valley in the Fiord District of South Island (in the company of Mssrs G. Simpson and J. S. Thomson). *Ranunculus Lyallii* is an important dominant of the subalpine meadows throughout the wet mountains of the southern and middle parts of South Island, *R. Buchananii* forms small meadow-fragments in wet rock-crevices, rock-ledges, rock-slides etc. in the alpine belt of the Fiord and South Otago Districts[1] only, and *R. Simpsonii*[2] is one of the most

[1] As to the Botanical Districts of New Zealand comp. Cockayne 1928.

[2] Possibly *R. Simpsonii* Ckn and Allan (1926 *b* p. 58) will turn out to be better treated as a subspecies of *R. sericophyllus* Hook. f. (Western District), with which it was united by Cheeseman (1925 p. 444) and which it replaces in the Fiord District. On Sealey Range in the Mount Cook region, where *R. sericophyllus* is abundant, I found a continuous series of biotypes connecting the typical villose forms with nearly glabrous forms indistinguishable from the true *R. Simpsonii* of the Fiord District. Further field-studies by New Zealand botanists must decide whether there is a comparatively narrow hybrid-zone between the pure *R. sericophyllus* - population of the north and the pure *R. Simpsonii* - population of the

important dominants of the open chionophyte-meadows[1] in the alpine belt of the Fiord District. *R. Buchananii* and *R. Lyallii* frequently meet on steep slopes along the alpine-subalpine border in the Fiord District, and in those places the highly polymorphic hybrid is found, forming a very fine series of transitional forms connecting the two species. In my rather rich collection of hybrid-specimens, the development of the pollen varies from individuals with n e a r l y all pollen-grains normally developed to such with more than 50% shrivelled. In one specimen a great reduction of the seed-production was observed, not 50% — and in some flowers much less — of the achenes being fertile; if this is the rule or not I do not know. I never saw the hybrid dominating. Even in the transitional belt the hybrid obviously has no chance in competition with the two species. — This is still more the case with the hybrid *R. Buchananii* × *Simpsonii*. Though those species are frequently growing quite near each other in the alpine belt (they are even frequently met together in the same community), the hybrid was found only in one place, namely on a large wet shingle-slip suitable for both species. The hybrid was very polymorphic, connecting the two species by a series of transitional forms; four extravagant individuals with more or less transformed petals were found. The pollen was bad: in many specimens nearly all pollen-grains were shrivelled, while in others nearly 50% (but not more) could be normally developed. Though a good number of individuals of the hybrid were found (growing among the mixed parent species), it was quite obvious that it had no chance at all in the competition.

None of those two *Ranunculus*-hybrids can be said to disturb the delimitation of the species in any considerable way. The hybrid-individuals are quite easy to pick out, and compared with the large populations formed by the pure species they play a very insignificant rôle in nature.

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south, in which case the two populations must be kept as species, or a more continuous transition, in which case they would be better treated as subspecies of one species (comp. above pp. 356—357).

[1] *Chionophytes* (from χίων= snow) are plants dependant of a very long snow-covering (= »Schneebodenpflanzen» in German). According to their relation to the length of the snow-covering (certainly one of the most important ecological factors in the alpine belt of all mountains) the alpine plant-communities may be divided into four groups: *chionophilous, subchionophilous, subchionophobous* and *chionophobous*.

In the New Zealand species of *Nothofagus* perhaps still better examples of this subtype of species-limits are found. *Nothofagus Solandri* and *N. truncata* have about the same main distribution-area in the *Beilschmiedia tawa*-belt of New Zealand (= the lower parts of North Island, except in the extreme north, and northernmost South Island), and to a large extent form mixed forests, but nevertheless the hybrid between those two species is only found in single individuals or a few trees side by side. Though the hybrid is highly polymorphic and evidently more or less fertile, forming a series of transitional forms connecting the two species, its vitality and power of competition are apparently so inferior to those of the two species, that the species can stand out as sharply delimited units even when growing together in the same forest, *e. g.* in the beech-forests near Wellington, where Dr. L. Cockayne and Mr. E. Atkinson kindly introduced me to this hybrid (comp. Cockayne and Atkinson 1926, Cockayne 1926 and 1929, Cockayne and Phillips Turner 1928.) — The hybrid *Nothofogus cliffortioides* × *fusca* is evidently more vital. It is common in the mixed *N. cliffortioides-fusca*-forest of South Island, is obviously quite fertile and exhibits an extreme polymorphy (Cockayne 1923, 1926, 1929, Cockayne and Atkinson 1926, Cockayne and Phillips Turner 1928). »Generally in *Nothofagus cliffortioides-fusca* forest, hybrids form a very small percentage of the trees, but perhaps 5—10 per cent occur with fair frequency. In some places, however, there may be at least 50 per cent of hybrids, but such spots are small in extent. Nevertheless, it is clear that the hybrids can well hold their own, a statement substantiated by the presence of hybrid seedlings in great numbers beneath hybrid trees. After a forest fire hybrids may occur in great profusion and the reinstated forest will certainly contain more hybrid trees than did the former community» (Cockayne 1929 p. 14). Still even this hybrid is not vital enough to prevent the two species from standing out as quite distinct units. When studying it in the Dart Valley and at Kinloch (W. end of Lake Wakatipu) I got the impression that the remarkable frequency of the hybrid in young forest mentioned by Cockayne and easily observed at Kinloch was only ephemeral, the vast majority of those young hybrid-individuals getting lost in the long run in competition with the parent species. In the mature *Nothofagus*-forest there is room only for quite few of the trees of the young forest, and in this

final tree-layer of giant *Nothofagus*-trees the hybrid-trees appear to have small chances to get a place. In old, mature *Nothofagus cliffortioides-fusca*-forest I never found more than single individuals of the hybrid. If the habitat is suitable for *N. fusca*, which is much more pretentious than *N. cliffortioides*, even the latter species appears to have small chances to survive in the very old forest.

In the second subtype of fertile hybrid-populations, comprising those with the vitality of the hybrid-population equalling that of the species concerned, we meet the most difficult cases of species-delimitation that may confront a taxonomist. In those cases, the species are saved from being completely swamped only by occupying different distribution-areas or at least different habitats in the same distribution-area. In the areas (or habitats) where they meet, they fleet together into one vast syngameon, the greater part of which may clearly belong to the hybrid. If this hybrid-area is much smaller than the areas occupied by the pure species-populations, the species may still stand out as quite distinct units. But if the hybrid-population is of a size comparable with that of the pure species-populations, the taxonomical treatment of the populations is extremely difficult. And still worse is the case when the hybrid-population tends to outnumber the pure species. But as long as some areas of considerable size are occupied by the pure species, there is still a possibility left to keep the species distinct, though in all those cases the question may arise whether it would not be a better method to treat the two species and the hybrid only as different subspecies of one heterofacial species. It is in those cases that pure herbarium-taxonomy proves to be utterly unable to solve the problems (and pure garden-genetics too!), and that the necessity of a geographical field-method will stand out in the most imperative way.

It is often rather difficult to decide whether a certain hybrid should be referred to this or to the preceding subtype. This is especially the case when the species concerned occupy only different habitats in the same distribution-area. In the hybrid *Geum rivale* × *urbanum*, for instance, it appears to be somewhat doubtful whether the comparatively small rôle played by the hybrid in nature is due partly to fertility- and vitality-factors (Almquist 1926 pp. 67—68, Turesson 1929 *a* p. 329) or only to the differences between the habitats of the two species and the

supposed scarcity of intermediate habitats (Winge 1926 *b* p. 594) combined with complex heredity of certain groups of characters (Winge 1928 p. 231). In the following discussion, however, I will try to choose such examples where little doubt is possible regarding the full fertility and vitality of the hybrids.

Let us begin then with some examples of species forming hybrids with full fertility and vitality, but still kept distinct by the adaptation of the two species to different habitats in the same main distribution-area.

The example of such species most frequently met with in genetical literature is the species-pair *Melandrium album* (*Melandrium pratense*, *Lychnis diurna*) and *M. rubrum* (*M. silvestre*, *Lychnis vespertina*). While geneticists of the purely experimental garden-school may fail to recognize those two species as natural units, owing to the full fertility and vitality of the hybrid (comp. Shull 1923), field-working taxonomists (and geneticists combining the experimental garden-work with comparative field-studies) find little or no difficulty in keeping the two species distinct. In the areas where both species occur, they occupy so different habitats that the hybrid cannot play any considerable rôle compared with the pure species (comp. Hagedoorn 1921 pp. 132—134). In Sweden only *M. rubrum* belongs to the indigenous vegetation, being common in somewhat wet forests of the meadow-type in most parts of the country, and extending even into the open meadows of the low-alpine belt (according to Turesson 1925 *a* pp. 184—189 it is differentiated in four more or less distinct »ecotypes» or subspecies). *M. album* here is an introduced weed hardly entering the indigenous plant-communities. According to Almquist (1926 pp. 66—67), the hybrid is especially common in cultivated fields in some parts of North Sweden, but it may be found everywhere where the two species grow near each other. It does not enter the indigenous plant-communities, and the wild *M. rubrum*-population mostly keeps quite pure.

A good example of species occupying so different habitats within the same area that the limit between them is kept distinct in spite of the vitality of the hybrid, is afforded by *Salix herbacea* and *Salix lapponum* in the mountains of Scandinavia. *Salix lapponum* is one of the dominants of the willow-scrub covering much of the moist ground in the low-alpine belt, while *S. herbacea* is a minute dwarf-shrub or even hemicyptophyte,

being one of the most important dominants of the middle-alpine and high-alpine belts (comp. Du Rietz 1930 p. 354), but in the low-alpine belt playing a rôle only in the extreme chionophyte-communities. The hybrid is quite fertile and exhibits a remarkable polymorphy, connecting those so different species by a series of forms (comp. Floderus 1909 pp. 25—27). It may be found wherever the species meet, and is mostly quite common especially along streams in the low-alpine belt. According to Floderus (l. c.) it may occasionally even »be so abundant that it forms large continuous mats lying so close to each other that they give a dominating character to the vegetation-picture». But this is only in especially favourable districts where there are large tracts of country belonging to the low-middle-alpine transition-belt. The vast majority of the *Salix herbacea*- and *S. lapponum*-populations are kept comparatively isolated from any chance of hybridizing with each other, and compared with those immense pure populations, the hybrid plays such a small rôle in nature that nobody would think of uniting *S. herbacea* and *S. lapponum* to one species or even considering the limit between them as »bad».

Analogous cases are easily found in the flora of New Zealand. One of the best examples is certainly that formed by *Dracophyllum filifolium* and *D. recurvum* (Oliver 1928, Allan 1928), which I had splendid opportunities to study on Mount Conspicuous in the Ruahine Range (under the guidance of Dr. H. H. Allan) and especially on Ruapehu (in the central part of North Island). Both species have their main distribution-area in the subalpine belt of the central mountains of North Island, though the area of *D. recurvum* extends to Hikurangi in the East Cape District and that of *D. filifolium* to Mt Egmont and to Cook Strait. *D. filifolium* is one of the dominants of the closed subalpine scrub, while *D. recurvum* is one of the two leading dominants of the open dwarf-shrub heath covering most of the wind-exposed ridges. In its typical state the latter species is a prostrate dwarf-shrub, while the former is an erect shrub. They are connected by a hybrid consisting of a most polymorphic series of forms and, if I may rely upon my own observations on Ruapehu, these exhibit a vitality fully equal to that of the pure species. In the dwarf-shrub heath of the wind-exposed ridges *D. recurvum* keeps pure, as *D. filifolium* does mostly in the closed scrub (though not to the same high degree), but in the open tall tussock (*Danthonia Raoulii*) vegetation

dotted with low shrubs the two species meet, and there the limit between them is completely smoothed out by the hybrid in its innumerable forms, mostly quite outnumbering the pure species. As much of this open tussock-country may be due to fire, the rôle played by the hybrid has possibly increased in comparatively recent years.

Another similar example is found in the same genus, namely the species-pair *Dracophyllum Oliveri*[1] and *D. prostratum*, both occurring on more or less boggy ground in the South Otago and

[1] Under this name I propose to raise Oliver's »*Dracophyllum longifolium* f. 3» (Oliver 1928 p. 702) to the rank of a species. Though Oliver is pointing out the compound character of his (and previous authors') *D. longifolium*, he provisionally keeps it as one species, dividing it into three forms only. As far as my experience goes, those three forms are quite as good and definite units as many *Dracophyllum*-species recognized by Oliver and previous authors, and the lumping of them to one species seriously hampers the discussion of their most interesting hybrids with other species. I therefore propose to raise them all to the rank of species. The name *D. longifolium* then must be kept for Oliver's f. 2, as Forster's *Epacris longifolia* (and Rob. Brown's *Dracophyllum longifolium*) clearly belongs to this species (type-locality Dusky Sound). Certainly this is a very compound species even in this restricted sense. — Oliver's f. 3 is a rather different population, by Cockayne (1928 p. 205) apparently referred not to *D. longifolium* but to *D. Urvilleanum* (*sens. ampl.*). It consists of much smaller shrubs with much shorter leaves closely resembling those of *D. rosmarinifolium* (= *D. uniflorum* Hook. f.) and with smaller racemes somewhat approaching those of the *D. Urvilleanum* - group. When Mr. Oliver and I stayed together at Manapouri, he kindly supplied me with good material of it from the bog E. of Manapouri mentioned by Cockayne. My own collections contain specimens of it from a bog in the lower Routebourn Valley (comp. below p. 375); probably also some somewhat deviating specimens with longer leaves from Maungatua should be referred to this species. When Mr. Oliver and I discussed it in Wellington before my departure from New Zealand, he was also inclined to raise it to the rank of a species. I propose to attach his name to it as an appropriate acknowledgement of his excellent and much-needed revision of the genus. — As to Oliver's f. 1, which includes the »*D. longifolium*»-population of the Auckland and Campbell Islands, Hooker already pointed out the difference between it and the *D. longifolium* - population of New Zealand proper, and in his »Flora novae-zelandiae» (1853) he even described them as two separate species. However, he referred o n e specimen from New Zealand proper, collected by Forster in Dusky Sound, to the subantarctic species, and therefore applied Forster's species-name *longifolium* to that species, while he gave the name *D. Lyallii* to the common species of New Zealand proper. Later on (1867) he again united the two species. Considering the geographical isolation of the two populations concerned, even the smallest c o n s t a n t difference between them should be sufficient to assure them the rank of separate species (comp. above p. 364). And as far as I know

Fiord Districts of South Island, the former species probably also extending further north. *D. prostratum* is a prostrate dwarf-shrub creeping and rooting in the peat of the extreme bog-communities (*Donatia-Oreobolus*-bog, *Sphagnum*-bog etc.[1]), while *D. Oliveri* is a low erect shrub hardly entering those communities. As far as I know, the two species mostly keep quite pure (the hybrid is not mentioned by Oliver 1928), but in a *Sphagnum*-bog in the montane belt of the lower Routeburn Valley (W. of Lake Wakatipu, near the junction of the Routeburn and the Dart Valley), I found a most bewildering multitude of forms gradually connecting the two species and evidently belonging to the hybrid, which here showed a great vitality and quite outnumbered the pure species. This bog was of a very peculiar type, apparently offering both species suitable conditions in the same plant-communities.

I cannot refrain from mentioning a third example from the same genus in this connection, namely the *Dracophyllum*-population of Campbell Island, which I had some opportunities to study in collaboration with Mr. W. R. B. Oliver. It consists of the two species *D. scoparium* (= *D. subantarcticum* Ckn) and *D. Cockayni-anum* (= *D. longifolium* f. 1 in Oliver's revision, comp. the note to

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there are even great constant differences between them: to those mentioned by Oliver there must be added one very important difference, namely the constantly pubescent upper surface of the adult leaves (but not of the juvenile ones, a remarkable difference noted already by Hooker 1847 p. 46) in the subantarctic population. In the true *D. longifolium* of New Zealand proper I have never seen anything like this pubescence; only in specimens from Stewart Island (Port Pegasus) I found a very slight pubescence on the upper surface of the leaves (of much shorter hairs than in the subantarctic population). I therefore do not hesitate in proposing to raise also the »*Dracophyllum longifolium*» of the Auckland and Campbell Islands to the rank of a separate species. Could any name be more appropriate for this beautiful tree than *Dracophyllum Cockayni-anum*, recalling the everlasting picture of subantarctic vegetation given by the grand old man of New Zealand Botany?

[1] In the subalpine belt, *D. prostratum* may be found also on dryer ground. It may then assume the life-form of a cushion-plant (on Bold Peak at the W. end of Lake Wakatipu I saw a big cushion sending out prostrate stems of the normal type). I have not been able to find any constant difference between this form and *D. muscoides* Hook. f. Specimens of the latter from the Old Man Range in Central Otago, kindly supplied by Mssrs G. Simpson and J. S. Thomson, have just the same leaf-size as *D. prostratum*, not smaller as should be the case according to Oliver 1928. If further field-studies should confirm the suspicion that *D. prostratum* and *D. muscoides* are only forms of one species, this species must be called *D. muscoides* Hook. f.

p. 374), and the hybrid between them (Cockayne 1928 p. 335, *D. insulare* Oliver l. c.). According to my own notes *D. Cockaynianum* was the dominant species (but mixed with *D. scoparium* and the hybrid in many forms) in much of the comparatively tall scrub traversed by myself on the southern side of Northeast Harbour, while in the literature the other species is always mentioned as the main dominant. Probably *D. Cockaynianum* may dominate only in the most protected tallest scrub, while the more low-growing *D. scoparium* plays the chief rôle in most of the scrub of the island; the latter species also grows dotted about in the open tussock-country (comp. Kirk 1891 p. 223, Cockayne 1904 pp. 274, 277). The hybrid appears to be abundant, fertile, vital, and very polymorphic, connecting the two species by a multitude of transitional forms. Nevertheless the two species have given all visitors the impression of two good and distinct units. This may be due to the comparative isolation of a large *D. scoparium* - population in the more open parts of the island. However, it may be well worth to look more closely into the *D. Cockaynianum* - population of the island, as I have some suspicions that all of it may be at least slightly »infected» with *D. scoparium* (the specimens I brought home from Campbell Island as pure »*D. longifolium*» have clearly shorter and more pubescent leaves than those from the Auckland Islands, where *D. scoparium* is lacking).

In this connection probably also the classical New Zealand hybrid *Coprosma propinqua* × *robusta* (*C. Cunninghamii* Hook. f.) should be mentioned (comp. Cockayne 1923, 1928, 1929, Allan 1924, 1926 *a*, *b*, 1929 *a*). Though both *C. propinqua* and *C. robusta* are distributed over at least most of the lowlands of New Zealand, they mostly appear to grow in different plant-communities (I got the impression that *C. robusta* is more at home in dense forest, while *C. propinqua* is frequently found also in more open scrubland). Especially in more or less swampy and not too dense forest they often meet (*e. g.* in Riccarton Bush at Christchurch, where this interesting hybrid-case was demonstrated to me by Dr. Cockayne and Dr. Allan), and then are connected by a very fertile and vital hybrid-population forming a complete series of transitional forms.

The examples given above all referred to species forming hybrids with full fertility and vitality but kept distinct by the adaptation of the two species to different habitats in the same main

distribution-area. The existence of large tracts of habitats suitable to one of the species but not to the other (and vice versa) guarantees, of course, the existence of pure populations of each species large enough to prevent the swamping of the two species to one large undifferentiated hybrid-population (comp. Hagedoorn 1921). Just the same thing will happen when two species, forming a fertile and vital hybrid, have geographically different distribution-areas overlapping only to a comparatively small degree.

It is quite easy to find any number of good examples of such species-pairs. One of the best European examples is certainly the species-pair *Veronica longifolia* and *V. spicata*. *V. longifolia* is a comparatively hygrophilous species characteristic for the alluvial meadows of North-eastern Europe, while *V. spicata* is a xerophilous stepp-species of more south-eastern distribution (Sterner 1922). In Sweden *V. spicata* has a typical southern distribution, while *V. longifolia* has its main distribution-area in the North-east (comp. Sterner l. c.). A comparatively distinct subspecies of the latter species (subsp. *maritima*) is very common on the small exposed islands of the Swedish east-coast N. of lat. 58°. In the southern part of this distribution-area, *V. longifolia* subsp. *maritima* meets *V. spicata* and is connected with it by a fertile, vital and very polymorhic hybrid-population. In the province of Upland, only pure *V. longifolia* subsp. *maritima* is found in the outer belt of the archipelago, and (some clearly synanthropous colonies of *V. longifolia* excepted) only pure (or at least nearly pure) *V. spicata* in the inner part of the mainland. But between those belts there is a transitional coastal belt where the hybrid is common and mostly quite outnumbering the pure species (comp. Almquist 1929 pp. 589—590). In a very rich collection made by me in the summer of 1908 in one of the classical localities for this hybrid (Fjäderholmarna in the harbour of Stockholm) there is a most bewildering multitude of hybrid-forms but not a single specimen that may be referred to either of the pure species. Probably both parent-species have entirely disappeared from this locality, the hybrid here appearing as a »Ganzwaise» in the sense of Gams (1923). Still this hybrid-zone is of such a small extension compared with the vast areas in which only one of the pure species are found, that probably no botanist would get the idea to call *V. longifolia* and *V. spicata* »bad» species.

Another good example is the species-pair *Helianthemum nummu-*

larium and *H. ovatum* in South Sweden (comp. Du Rietz 1923 *b*, 1925). *H. nummularium* has a more eastern, *H. ovatum* a more south-western distribution in South Sweden. In the province of Blekinge, only pure *H. nummularium* is found in the east and only pure *H. ovatum* in the west, but in the middle there is a zone with both species growing together and connected by a fertile, vital and very polymorphic hybrid-population. In this hybrid-zone certainly no distinct limit can be traced between those species so distinct in the greater part of their distribution-areas.

A multitude of analogous cases have been described during the last decade from New Zealand in a series of important papers by Cockayne and Allan (1923—1929).

In several of those cases one of the two related species has a more northern and the other a more southern distribution overlapping only to a comparatively small extent. Those species may be quite distinct and very different-looking units in the areas where only one of them is present, and still join into one vast and most polymorphic hybrid-syngameon in the area where they are meeting. One of the best known examples for this type is the species-pair *Myrtus bullata* and *M. obcordata* (Cockayne 1918, 1923, 1929, Cockayne and Allan 1927, Cockayne and Phillips Turner 1928, Allan 1929). From the south of South Island up to about lat. 41° only pure *M. obcordata* is found, and in the northern part of North Island (north of lat. 36°) only *M. bullata* (except in two very small areas), but between lat. 41° and 36° both species frequently grow together connected by a most luxuriant transitional population of the very polymorphic hybrid (previously known as a species under the name of *M. Ralphii* Hook. f., demonstrated to me by Dr. Allan in Kitchener Park at Feilding).

In other cases one of the two species is restricted to the coastal scrub while the other has a wide inland distribution. *Hebe elliptica* and *H. salicifolia* form the best example for this type, the former one of the chief dominants of the coastal scrub of South Island (extending its distribution-area to the subantarctic islands of New Zealand and even to the Falkland Islands and subantarctic South America), the latter common in the lowlands throughout New Zealand and frequently meeting *H. elliptica* in the coastal scrub of South Island. In those places a highly polymorphic hybrid connects the two species (Cockayne 1923, 1925, 1928 p. 105,

Cockayne and Allan 1926, 1927, Allan, Simpson and Thomson 1926). Upon various forms of this hybrid the old species *Veronica* (*Hebe*) *amabilis* Cheesem. and *V. blanda* (Cheesem.) Pennell were founded. The high polymorphy and vitality of the hybrid is clearly demonstrated by the thorough analysis of Allan, Simpson and Thomson (l. c). I saw it only in two localities (Punakaiki in the Northwestern District, where it was introduced to me by Dr. Cockayne and Dr. Allan, and Deep Cove in Doubtful Sound), but I got the impression that it does not enter the most exposed scrub, this being formed by pure *Hebe elliptica.*

In the New Zealand flora there are also several cases of one lowland and one mountain species connected by a luxuriant and highly polymorphic hybrid-population confined to a certain altitudinal belt. *Aristotelia serrata* is a large-leaved low tree common throughout the forested part of New Zealand up to about the lower limit for the prealpine forest-belt[1], *A. fruticosa* a small-leaved divaricating scrub having its main distribution-area in the prealpine and lower subalpine belts and in the dry low tussock region of the Eastern side of South Island, but also frequently occurring in the montane forest-belts (comp. Cockayne 1928, 1929). In these montane forest-belts the two species may not only be connected but even outnumbered by their very polymorphic hybrid (comp. Cockayne 1923, 1925, 1928, 1929, Cockayne and Phillips Turner 1928, Allan 1927 *a*, previously known as a species under the name *A. Colensoi* Hook. f.) which may ascend even a good bit higher than the pure *A. serrata*[2] (according to observations made in the Routebourn Valley together with Mssrs G. Simpson

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[1] I am using the term »prealpine belt» for the uppermost forest-belt of the New Zealand mountains (characterized by *Nothofagus cliffortioides, N. Menziesii, Libocedrus Bidwillii, Podocarpus Hallii* and *Dacrydium biforme* as main dominants in the tree-layer, by the constant absense of *Weinmannia racemosa, Metrosideros lucida* and other trees common in the montane forest-belts, and by a shrub-layer mostly very dense and more or less resembling the subalpine scrub, with which it has many species in common), restricting the term »subalpine belt» to the scrub and tall tussock belt above timber-line. Cockayne's (1928) »subalpine belt» thus includes both my »prealpine» and »subalpine» belts as well as parts of my »upper montane» belt. My terminology in this matter is based upon an attempt to work out a generally applicable terminology for the altitudinal vegetation-belts of the earth, that will be published shortly.

[2] Hybrids occurring in this way outside the range of one parent-species are called »Halbwaisen» by Murr (1919) and Gams (1923).

and J. S. Thomson). On the Ruahine and Tararua mountains, where this hybrid was first demonstrated to me by Dr. Allan, it appeared to be one of the most frequent shrubs of the montane and lower prealpine belts, and certainly posessed a vitality at least equalling that of the two pure species. — A similar case is that of *Coprosma grandifolia* and *C. tenuifolia*. The former is a large-leaved forest-shrub common in the lower forest-belts of North Island and northernmost South Island (= the *Beilschmiedia taraire*- and *B. tawa*-belts). The latter is a more small-leaved shrub confined to the higher forest-belts of the middle part of North Island (according to Cheeseman 1925 from Mt Te Aroha and Hikurangi in the North to Mt Egmont and the Ruahine Mts in the South, and not recorded below 1000 ft). In this area also the hybrid is found (Allan 1928, Cockayne and Phillips Turner 1928, Cockayne 1929). After having made its first aquaintance on the Ruahine Mts with Dr. Allan, I got good opportunities to study it more closely during a stay in the Tongariro National Park (between Raurimu and Waimarino, on Hauhungatahi and at Ohakune). The hybrid is very polymorphic, forming a fine transition-series between the two species. As to its vitality, I got the impression that it was about as equally common and vital as both species. According to my notes, both species were common together with the hybrid up to the lower prealpine belt (= a little above 1100 m), where they disappeared simultaneously. However, what I brought home from the montane belt as pure *C. grandifolia* proved to be considerably more small-leaved than the guaranteed pure *C. grandifolia* of the lowland. I therefore have some doubts whether absolutely pure *C. grandifolia* really occurs on the Volcanic Plateau much above the upper limit of the tawa-belt (about 600 m). On the Tararua Mts, where *C. tenuifolia* is absent, I noted the highest isolated individuals of *C. grandifolia* at about 730 m, and in South Island it apparently does not much exceed the limits of the tawa-belt. So it may well look possible that the existence of a montane *Coprosma grandifolia*-population on the Volcanic Plateau may be due to the crossing of the pure *C. grandifolia* of the lowland with the more cold-resistant *C. tenuifolia*. As to the latter species, I hardly ever saw it isolated from the hybrid-population. It does not seem impossible that the whole *C. tenuifolia*-population has got the opportunity of being »infected» with *C. grandifolia*. So we may here have one of those troublesome

cases where hybridization has gone far enough to become a serious menace to the autonomy of at least one of the species involved.

This leads us over to the extreme cases in which the species are more or less lost in an overwhelming majority of highly polymorphic hybrid-populations. Many such cases have been described during the last decades by the Swedish school of salicologists (S. J. Enander, B. Floderus etc., comp. especially Floderus 1909, 1912, 1923, 1926 *a, b*) — and their views certainly cannot be lightly dismissed, as they are founded upon intensive field-studies carried out during half a century and extended over large parts of the Northern Hemisphere. In the later works of Floderus there is an increasing tendency to class most of the *Salix*-population of the arctic and subarctic regions as hybrids, and to restrict the species-concept to include only populations of the most extreme purity. Thus there are quite a lot of Swedish *Salix*-species that according to Floderus are hardly ever found pure in Scandinavia. As long as pure populations of those species are admitted to occur in other parts of their distribution-area, this method of treatment may be easily defended. But, if I have not misunderstood Floderus' recent papers, many of his species never form pure populations of any extension, those species thus being known o n l y as single individuals or very small populations accidentally found here and there in the highly polymorphic syngameons classed by Floderus as hybrids. In those cases it may well be asked whether we are not on a dangerous road that may easily lead to complete dissolution of any practically applicable species-concept in those populations.

If, as often happens, two *Salix*-species frequently hybridize in a certain region, and the hybrid is fertile, vital and easily crossed back with the two species, the genetical constitution of the two species-populations is easily changed to such an extent, that practically every individual of one of the species will show at least some slight traces of the other species. Thus, according to Floderus, the whole *S. nigricans*-population of the Scandinavian mountain-districts shows distinct traces of *S. glauca* and *S. phylicifolia*, *i. e.*, nearly every individual of *S. nigricans* in those districts has taken up at least some genes from the neighbouring *S. glauca*- and *S. phylicifolia*-populations. And according to the same author

the *S. nigricans*-population of South Sweden is constantly »infected» in the same way by *S. cinerea* (and often also with some other species). As a consequence of those statements Floderus refers practically the whole *S. nigricans*-population of North Sweden to the hybrids *S. nigricans* × *phylicifolia*, *S. glauca* × *nigricans* and *S. glauca* × *nigricans* × *phylicifolia* (or to hybrids of still more complicated constitution), while the *S. nigricans*-population of South and Middle Sweden is referred to the hybrid *S. cinerea* × *nigricans* or to other, more complex, hybrids. — In the same way Floderus treats the very polymorphic *Salix*-population of Greenland considered by him to be formed by the hybridizing of *S. arctica*, *S. chloroclados* and *S. glauca*. Most of the population of North Greenland is classed as *S. arctica* × *glauca*, most of that of Middle Greenland as *S. arctica* × *chloroclados* × *glauca*, and most of that of South Greenland as *S. chloroclados* × *glauca*. The pure species are considered to be rare, *S. glauca* being found over the whole country, but *S. arctica* lacking in the south and *S. chloroclados* in the extreme north.

This method of treatment, of course, involves the theory that the species distinguished are the primary units and the main population classed as hybridsis younger than those. This, however, is not proved. It appears quite possible that the smaller and more uniform populations classed as species are secondary units differentiated from the highly polymorphic syngameon classed as a complex of hybrids, or even only extreme forms accidentally appearing, disappearing and reappearing within this syngameon. In such a highly polymorphic syngameon any form of sufficient vitality may simulate a primary species if isolated, and to some extent even if not isolated. In a case like that of *Veronica longifolia* and *V. spicata* (comp. above p. 377), where it is quite obvious that the two species have immigrated from different directions (comp. Sterner 1922), the secondary nature even of a most vital hybrid-population may be taken as proved. The same may be said even of other highly polymorphic hybrid-populations occupying a comparatively narrow zone between two species widely distributed in their pure state. But as soon as the highly polymorphic hybrid-population is of a size equalling or surpassing that of the pure species-populations, suspicion may arise that the »hybrid» is older than the »species», and that the latter are simply secondarily isolated segregates of the highly poly-

morphic »hybrid». And this suspicion will be still stronger when the »species» do not even form pure populations but only appear as single individuals here and there in the highly polymorphic »hybrid». Good examples of cases in which very little or nothing talks in favour of the primary nature of the supposed »species», are furnished by Gunnarsson's monograph of the genus *Betula* in Scandinavia (1925, comp. Lotsy 1925 *b* and Arwidsson 1930) — an unfortunate attempt to apply the Floderian *Salix*-method to a rather hopeless, highly polymorphic syngameon in another genus.

Polymorphic syngameons more or less analogous to those found in *Salix* and *Betula* are found also in several New Zealand genera. The genus *Alseuosmia* (Caprifoliaceae, forest-shrubs of the northern part of North Island), for instance, appears to consist of one vast and immensely polymorphic syngameon (Cockayne 1923, 1925, 1928, 1929, Allan 1926 *c*, Cockayne and Allan 1927), only conventionally divided in a few species of which Cockayne writes as late as 1929 (p. 21): »Whether there are really the above species of *Alseuosmia*, I have no idea.» What I saw of it in the field made me seriously doubt that it will ever be possible to get a natural division of it into species and hybrids. — *Senecio Lyallii* and *S. scorzoneroides* are two species of subalpine meadow-herbs distributed throughout the mountains of South Island and Stewart Island, mostly occurring together and then always connected by a highly polymorphic hybrid (Cockayne 1923, 1925, 1928). If I may rely upon my own observations, this hybrid quite often outnumbers the pure species. In this case it appears equally probable that the »species» are segregates of the hybrid as that the hybrid was formed by the meeting of two species originally isolated. If we follow the modern New Zealand taxonomists in considering the two species as valid, we probably here get a case similar to those of northern Salices, namely a hybrid playing a greater rôle than the pure species. — In the genus *Celmisia* several analogous examples are found. While in some sections of that genus the species are rather distinct, and the hybrids either sterile (comp. above pp. 365—366) or fertile but not vital enough, or at least not abundant enough to spoil the species-limits (*Celmisia coriacea* × *Traversii*, and *C. spectabilis* × *Traversii*, comp. Cockayne 1915, 1923, 1925, 1928[1]),

[1] A series of forms of these hybrids, collected by myself on the southeastern spurs of Mt Captain (Northeastern District), showed no reduction of the pollen-production.

there are other sections giving the impression of rather hopeless, extremely polymorphic syngameons analogous to the worst northern *Salix*- and *Betula*-populations. Thus the series of forms treated in Cheeseman's Manual as *C. brevifolia* and *C. novae-zelandiae* gave me the impression of forming one very polymorphic syngameon (splendidly developed on Mt Wakefield in the Mount Cook region), probably only in some peripheral parts differentiated into pure populations of short-leaved (*C. brevifolia*) or long-leaved (*C. novae-zelandiae*) forms. Very nearly related and possibly intergrading into this syngameon is the very large and exceedingly polymorphic syngameon probably formed by *C. incana* Hook. f., *C. discolor* Hook. f., *C. intermedia* Petrie, *C. Bonplandii* (Buch.) Ckn, *C. Du Rietzii* Ckn and Allan, and perhaps some other species too. It is distributed throughout the New Zealand mountains. Round its margins smaller parts of it appear to have become isolated either in outlying mountains or on coastal cliffs [*e. g.* the northernmost subspecies of *C. incana* in North Island (comp. Cockayne and Allan 1927 p. 269), *C. holosericea* in the Fiord District, *C. Lindsayii* on the south-eastern coast of South Island], some of them differentiated as quite distinct species, but in its more central parts the syngameon presents, at least to the botanist making a comparatively short visit like myself, the picture of a most intricate network of rather different forms hopelessly mixed with each other and apparently all crossing. If this extremely polymorphic syngameon has been formed by hybridization of a number of more uniform species, the latter appear to have got lost at least to the same degree as many of the arctic species of *Salix* — but if my very incomplete impression of this vast syngameon may be of any value, I would rather believe that the small more uniform local populations occasionally found are simply secondary segregates of the highly polymorphic syngameon. How this syngameon first was formed is another matter — of course it may have been formed by the crossing of species differing from all those local populations presently found. But about this matter we had better confess our complete ignorance.

The practical taxonomical treatment of those large and highly polymorphic »hybrid»-syngameons in which the species have got more or less lost — or never have been differentiated — is one of the most difficult matters confronting the taxonomist of the present day. The Floderian method of picking out some more or less

rare forms as species, and classing the bulk of the syngameon as more or less complex hybrids between them, is possibly the most logical consequence of the methods applied to less complex syngameons. But the danger of this method is also quite obvious. Even if we admit that the frequency of vital »extravagant» forms in wild hybrids has been exaggerated by HERIBERT-NILSSON and other geneticists, attempting to prove the impossibility of determining wild hybrids without experiments, there is always a chance that a certain form intermediate between two others may have arisen from a cross of two other forms than those expected. And certainly the reconstruction of all those »triple»- and »quadruple»-hybrids in salicological literature is a very dangerous business. With full certainty we shall probably never know whether those highly polymorphic syngameons are not the result of early crosses of quite other species than those now differentiated in the outskirts of the syngameons.

The opposite extreme would be to treat the highly polymorphic syngameons simply as what they are at present, without any hypothetical considerations as to the species from which they are supposed to have originated by crossing. This would imply the naming of the highly polymorphic syngameons simply as species and the dividing of them into subspecies, varieties and forms, just as other compound and heterofacial species are divided. The extremely polymorphic *Salix*-population of Greenland mentioned above would thus be treated simply as one species and be divided into one northern subspecies (= FLODERUS' *S. arctica* × *glauca* + the rare individuals of pure *S. arctica* and pure *S. glauca* found in this region), one middle subspecies (= FLODERUS' *S. arctica* × *chloroclados* × *glauca* + the rare individuals of these three Floderian species in this region), and one southern subspecies (= FLODERUS' *S. chloroclados* × *glauca* + rare individuals of *S. chloroclados* and *S. glauca*). But I strongly fear that the consequent application of this method would lead to the dividing of the boreal *Salix*-population into very few and extremely compound species, very difficult to handle and each consisting of so extremely different forms that they would be of little value as units for ecology and all the other branches of botany that taxonomy has to serve. And I must confess that even my taxonomical mind strongly revolts against the idea of lumping two so different populations as pure *Salix arctica* and pure *S. glauca* into one species.

Still I think this method is the only one applicable in the case of *Betula*, the Scandinavian *Betula*-population probably containing only two recognizable species, *Betula nana* and *Betula alba* (connected by a highly polymorphic hybrid of too moderate vitality to spoil the species-limit). Also in the cases of *Alseuosmia, Senecio Lyallii-scorzoneroides,* and the *Celmisia discolor*-group it may be sound to try this method parallelly with the others.

The third method possible is a compromise, used at present by many Scandinavian taxonomists and ecologists, whose limited knowledge in the mysteries of modern salicology has simply forced them to adopt it in their field-work. According to this compromise-method, the species are simply delimited in a less rigorous sense than the Floderian one, and only the forms clearly intermediate between the pure species are included in the hybrids. The establishing of triple- and quadruple-hybrids is generally avoided except in quite undisputable cases. This method implies the admission that a part of a species-population may be changed slightly by »hybridogenous infection» of other species and still remain within the limits of the species concerned. Considering the great polymorphy admitted in many species when due to other causes, this appears to be a rather sound admission. Of course it will then be a purely practical question where the limit between the hybrid *sensu stricto* and this species *sensu amplo* should be drawn. By this method most of the *Salix nigricans*-population of South and Middle Sweden is simply classed as *S. nigricans,* in spite of its apparent hybridogenous infection of *S. cinerea* etc., and most of the North-Swedish *S. nigricans* too, in spite of the infection of *S. phylicifolia* and *S. glauca.* How the *Salix*-population of Greenland mentioned above should be treated according to this method I do not know, but possibly a good deal of it would come in under the species *S. arctica sens. ampl.*, *S. glauca sens. ampl.*, and *S. chloroclados sens. ampl.* [= *S. groenlandica* (Anderss.) Lundstr.]

Syngameon, commiscuum and convivium.

In the above discussion I have consequently used Lotsy's term »syngameon» in a rather wide sense, *i. e.* as a short and handy term for any intercrossing population not divided by distinct lines or zones of discontinuity. A syngameon in this sense may be either a commiscuum or a part of a commiscuum in the

sense of Danser (1929 *a, b*). According to Danser, a commiscuum includes all individuals connected by a genetical possibility of »Vermischung», *i. e.* exchange of genes. Populations prevented from crossing only by geographical isolation according to Danser still belong to the same commiscuum, but each of them forms a separate convivium (Danser 1929 *b*). According to the definition and the examples given by Danser, his convivia are identical with the »species» of Hagedoorn 1921, *i. e.*, any population more or less differentiated from its relatives and tending to reduce its potential polymorphy may be called a convivium. As the convivia of Danser must only be »mehr oder weniger scharf unterscheidbar», they may in some cases correspond to our species, in other cases to our subspecies or even varieties (this is clearly shown not only by Danser's definition but also by his examples). A commiscuum, on the other hand, is often identical with a species, but it may also include several species, if they are actually connected by fertile hybrids, or if they are prevented from being so only by geographical isolation.

An important fact pointed out by Danser is the possibility of »Vermischung» (exchange of genes) of two biotypes, even if they are not fertile with each other, but both form fertile crosses with a third biotype. Thus it is not necessary that all biotypes in the same commiscuum (or in the same syngameon) should be capable of direct crossing. The occasional occurrence of intraspecific sterility pointed out by several geneticists (comp. for instance Winge 1926 *a*, Turesson 1929 *a*, Münzing 1929, 1930) does not therefore affect the validity of our species-definition.

Practical methods of species-taxonomy.

From what has been said above regarding the delimitation of species it will be clearly seen that the pure »abstraction»-method of species-making by sorting specimens into groups merely after their morphological resemblance, as still practised by many taxonomists [and still supposed by Lotsy (1921, 1925 *b*) and many other geneticists to be the method of all taxonomy], must be firmly rejected, and that the »morphologic-geographical method» so brilliantly advocated and demonstrated in the 'nineties by Wettstein and his followers, must come to its right again not only in zoology, where it has been practised with eminent results during the last decades, but also in botany, where it unfortunately appears to

have fallen into some discredit or oblivion after the Wettsteinian period. It must not be forgotten that taxonomy not only deals with abstract concepts, but in the first line with living populations. And certainly those populations must be studied in the field much more than is mostly the case in present-day taxonomy. Though I am inclined to think that Cockayne and Allan are somewhat underrating the possibilities of studying a population by means of herbarium-material (if this material is well preserved and rich enough to give not only examples of the populations concerned but also some idea of the regional and local variability of its polymorphy), their strong emphasizing of the need of F i e l d-T a x o n o m y certainly cannot be supported enough (comp. also Fries 1852 pp. 194—210, Samuelsson 1922 p. 229, Hall and Clements 1923 p. 15, Du Rietz 1930 p. 295). And certainly there is something fundamentally wrong with taxonomy as long as many of those who are put to carry out most of the monographical work, namely the officials of the great botanical museums, are forced by antiquated regulations to spend practically all their time in indoor museum-work — while a modern botanical museum-official, of course, ought not only to be allowed but even forced to spend at least several months of the year in field-study of the populations he has to deal with in his museum during the rest of the year.

The importance of genetical methods in species-taxonomy cannot, of course, be overrated — as long as those methods are not supposed to r e p l a c e the study of wild populations in their natural habitat, or the necessary comparative museum-work with those populations. If we take home a single specimen (or a few specimens) of each species, of each subspecies, or even of each variety of a genus, plant them in our gardens, cross them with each other and play with them in various ways, they will still tell us nothing about the variability of polymorphy in the wild populations concerned, *i. e.* nothing of what is most essential for grasping the species and their subordinate units. The field-study of the variability of polymorphy in wild populations can be replaced as little by the study of a few living individuals brought home to a garden as by a few dry individuals in a museum, and it is often of more use to get a number of dry individuals sufficient for getting at least some idea of the variability of polymorphy in the wild population than it is to get an i n s u f f i c i e n t number of living individuals to a garden. The claim of Turesson (1926 *c*)

and other geneticists to have replaced the old »descriptive taxonomy» with a new »experimental taxonomy» must therefore be firmly disputed. In this statement there lies no underrating of the importance of garden-experiments as a complement to the comparative field-study combined with comparative museum-work. But even the elimination of the phenotypical variability of a population can certainly be done to a much greater extent by means of a comparative field-study, than is admitted by most geneticists believing this to be possible only in their experimental gardens.

The practical methods of describing species cannot be discussed here in any detail. Still it must be mentioned that the general recognition of species as populations, mostly consisting of a great number of forms often grouped to distinct local and even regional facies (varieties and subspecies), makes a revision of the traditional method of describing species rather necessary. At present a diagnosis of a species may be founded upon one individual or upon several individuals belonging to one or several forms, varieties or even subspecies — and about this mostly nothing at all is told in the diagnosis. When the diagnosis tells us that the leaves have a certain variability, nobody knows whether this refers to one individual or to many individuals, nor what the relation is of those many individuals to each other. The recent proposition of Gallöe (1928) that a diagnosis of a species should be founded upon one single individual, must certainly be taken into serious consideration — but of course this description of one single individual cannot be sufficient to characterize the species concerned. The best method would probably be to give 1) one diagnosis of the type-individual, 2) one description of the polymorphy of the type-variety (*i. e.* the local population to which the type-individual belongs), and 3) one description of the variability of polymorphy in the whole species. If distinct subspecies are differentiated, also the variability of polymorphy in those should, of course, be separately described. If many branches are taken from a shrub or a tree and placed upon different herbarium-sheets, all of these must, of course, be considered parts of the type (not co-types, as often practised at present). If, on the other hand, several individuals of small plants are placed upon one herbarium-sheet, only one of them may be designated as the type (not the whole sheet, as is the present practice). The

term »co-type» ought then to be restricted to individuals taken in the same locality as the type and supposed to belong to the same biotype or being at least practically indistinguishable from the type (very often the type forms a part of a clone or a more or less autogamous and inbred population of practically undistinguishable individuals).

The practical application of this method I hope to be able to demonstrate shortly in another paper.

11. **The hybrid.**

A hybrid is a population intermediate between two or several different species, supposed to be originally formed by the crossing of biotypes belonging to different species.

This hybrid-concept probably coincides with what most biologists have called and still call a hybrid. As mentioned above (p. 342), however, also another very different hybrid-concept has been advanced during the last decades. According to Lotsy (1916 etc.) and Raunkiaer (1918) every heterozygous biotype should be called a hybrid. As the strict consequence of Lotsy's and Raunkiaer's hybrid-definition turns out to be that every sexual species in our sense would consist exclusively of hybrids *sensu* Lotsy (even according to Lotsy's own opinion, comp. above p. 341), the practical applicability of this hybrid-concept appears at least rather dubious. Practically, even Lotsy himself does not use it strictly in his own hybrid-studies, using the term »hybrid» only for biotypes intermediate between two »Linneons» (= our species, comp. for instance Lotsy and Goddijn 1928). Still this is something rather different from our hybrids. For highly polymorphic hybrids in our sense Lotsy (l. c.) uses the terms »hybridogenous populations» (»populus hybridogenus»), »hybridogenous crowd», »hybrid swarm» etc. Lotsy's hybrid-terminology is adopted also by Cockayne and Allan (1923—1929), who use the term »hybrid» for any biotype intermediate either between two species or between two »jordanons» (comp. above p. 350), and the term »hybrid swarm» for any highly polymorphic hybrid in our sense.

The various types of hybrids in our sense have been dealt with in detail above in connection with the species, so no further dis-

cussion of them is necessary. Like a sexual species, a hybrid may be more or less polymorphic, consisting of a very great number of biotypes. In fertile and highly polymorphic hybrids these biotypes form a syngameon just like the biotypes in a sexual species. Between a highly polymorphic hybrid and a highly polymorphic species there is no fundamental difference, and therefore it is often very difficult to decide if a highly polymorphic population should be classed as a species or as a hybrid. A highly polymorphic hybrid may develop to one or several species by more or less effective isolation from the parent species. Still most highly polymorphic hybrids are considerably more polymorphic than most species, and the high potential polymorphy of the hybrid is then protected from being reduced by the constant crossing back with the two parent species, and the constant appearing of new crosses between them. Using HAGEDOORN's (1921) species-definition we may say that a species tends to reduce its potential polymorphy, while a hybrid does not tend to reduce it — if not isolated from the parent species, in which case it either disappears or assumes the character of a new species.

The discoveries of cytological anomalies in many hybrids during the last decades have made some botanists believe that cytology is always able to tell whether a certain biotype belongs to a species or to a hybrid. Unfortunately this is not the case. There is no constant fundamental cytological difference between species and hybrids. Some hybrids (between species with different chromosome-number) are easily recognized by cytological anomalies (but then mostly also by reduced fertility or at least vitality), but other hybrids (between species with the same chromosome-number) are even cytologically indistinguishable from their parent species.

During the last years there has been much discussion regarding the methods of naming hybrids. The traditional method of using a formula consisting of the names of the parent species (*e. g. Veronica longifolia* × *spicata*, *Dracophyllum filifolium* × *recurvum*) is clear but not very handy. Many botanists therefore give a binary name also to hybrids (*e. g.*, × *Veronica hybrida*, × *Dracophyllum arcuatum*) which is used alternating with that somewhat complicated hybrid-formula. This may be convenient when it is uncertain whether the population concerned should be classed as a species or as a hybrid, but in other cases it appears to imply the burdening of nomenclature with a rather unnecessary name.

In the International Rules, the giving of binary names to hybrids is recommended »whenever it seems useful or necessary» (Art. 31). The method of naming hybrids by abbreviated formulae as proposed by Cockayne and Allan (1926 *c*, 1927 etc.), is certainly very handy in verbal discussions, notebooks etc., but for botanists less familiar with the flora concerned it may often be hard to understand that *Nothofagus cliffusca* means *Nothofagus cliffortioides* × *fusca*, *Hebe ellipsala Hebe elliptica* × *salicifolia*, *Aristotelia fruserrata Aristotelia fruticosa* × *serrata*, *Ranunculus Buchlyallii Ranunculus Buchananii* × *Lyallii*, etc. In scientific literature I therefore prefer writing out the whole formula. Cockayne and Allan severely criticize the method of giving binary names of the ordinary type to hybrids, pointing out that most of those binary names in use were originally given only to one form or a small group of forms within a highly polymorphic hybrid-population, and therefore cannot be considered representative for the whole hybrid. This is certainly quite right, but just the same may be said of most species-names also, though the matter perhaps becomes more disturbing in polymorphic hybrids because of the great differences between the form originally described and many other forms of the hybrid. To me it appears to be merely a matter of taste and convenience, whether we use those old species-names or the abbreviated formulae of Cockayne and Allan as more handy substitutes for the complete hybrid-formulae.

12. **The units superior to the species.**

The taxonomical units superior to the species can hardly be called »fundamental» to the same degree as the species and its subordinate units, since the delimitation of the higher units is to much greater an extent a matter of taste and convenience. Every taxonomist knows how hopelessly opinions differ regarding the delimitation of genera and other units of higher rank. It is not my purpose to discuss those higher units in any detail in this paper. Only some of the general principles for the delimiting of those units will be briefly discussed here.

As was shown above (pp. 352—353), it is quite easy to understand the differentiation of a species into regional and local facies in the light of what I would propose to call Hagedoorn's law of

differentiation by means of automatic reduction of potential polymorphy — even without the assumption of any rôle played by induced or non-induced mutations, nor by selection. In this connection it was also mentioned that just the same process may often lead to the differentiation of a syngameon into different species, if the syngameon is split up into parts more effectively isolated from each other. This effect of isolation was clearly recognized already by Leopold von Buch (1825, comp. Wagner 1889 p. 344) and Moriz Wagner (1868—1889), and this idea was built out to an elaborate theory by the latter author (the »migration-theory», later changed to the »separation theory»). But the mechanism of differentiation in the absence of any mutation could, of course, not be recognized by those authors (though the importance of inbreeding was clearly pointed out by Wagner, comp. for instance 1889 p. 401), as this recognition depends upon genetical experiences not available at that period (comp. Hagedoorn 1921 p. 120). Of course nobody knows what would have happened, if Mendel's work (1865) had been known to Wagner, and Hagedoorn (1921 p. 120) may be right in assuming that »Wagner would have greatly appreciated it, and could have been trusted to incorporate it into a really logical evolution-theory». As it was now, however, Wagner had to look for another explanation to the effect of isolation, and he believed to find that explanation in the production of new forms (mutations), to a great extent directly induced by the environment (as assumed also by von Buch) and saved by isolation from being swamped in the original main population [the clearest summary of his views in this respect is probably found in pp. 472—473 in his »Gesammelte Aufsätze» (1889)]. He strongly opposed Darwin's selection-theory (1859), considering the struggle for life to be »nur eine unwesentliche begleitende Erscheinung der Differenzierung, d. h. ein nur zeitweilig mitwirkender und nebensächlicher Faktor dieses Prozesses» (Wagner 1889 p. 462[1]). Unfortunately Wagner's ideas found

[1] Many years after Wagner's death, his opposition in this point was characterized by Hagedoorn (1921 p. 120) in the following words:

»Darwin lacked the necessary key at the time when he needed it most, and when he came into touch with Wagner's work, it could not shake his faith in selection as the cause of stability of species. All the recent work in Genetics, Mendel's law, the things we have since learned about the nature of the genes, the selection experiments with the most diverse material, have shown us that Wagner in opposing Darwin in this fundamental point had the right wholly on his side.»

little recognition both in the dominating Darwinian school of his time (comp. for instance Darwin 1869 pp. 119—122, Haeckel 1868, Weismann 1868, 1872, Seidlitz 1871, and Wallace 1889) and among anti-selectionists like Nägeli (1872, 1884). But the idea of isolation as the dominating factor in the formation of new species got new strength by the fundamental works of Gulick (1872—1905) and Romanes (1886, 1897). While Wagner had recognized the importance of spatial isolation only, Gulick and Romanes — independently of each other — were the first to realize the full importance of physiological isolation, and to work out »the general theory of isolation» summarized by Romanes (1897 p. 145) in the following words: »Without isolation or the prevention of free intercrossing, organic evolution is in no case possible.» In the first years of the new century, similar lines of thought were followed by Mayer (1902), D. S. Jordan (1905), K. Jordan (1905) and several other authors, and in the last decades the idea of isolation as the main factor in species-formation has steadily won new ground among biologists[1].

Parallelly with this development the traditional theory of a divergent evolution has gradually lost ground, not only among geneticists but also (earlier than among geneticists and certainly unnoticed by most of them) among those ecologists carrying out field-studies of plant and animal distribution. In 1906, Guppy advanced his differentiaton theory, founded upon extensive studies of plant-distribution and worked out more elaborately in a series of subsequent publications (comp. for instance Guppy 1907 and 1917), and in 1907 very similar views were expressed by Willis (comp. also Willis 1922, 1923), independently of Guppy but founded upon analogous researches in other parts of the world. According to Guppy's differentiation theory, »the rôle of the polymorphous species belongs alike to the plant and to the bird. A species that covers the range of a genus varies at first in every region and ultimately gives birth to a new species in some parts of its range. Then the wide-ranging species disappears and the original area is divided up into a number of smaller areas each with its own group of species. Each smaller area breaks up again, and forms, yet more specialized, are produced; and thus the process of subdivision of range and of differentiation of form goes

[1] Of more recent authors clearly opposing this idea, H. de Vries (1903 p. 507) must be specially mentioned.

along until each island in an archipelago owns its bird and each hill and valley has its separate plants.» (Guppy 1906 p. 522.) The contrast between this theory and the traditional theory of divergent evolution is summarized by Willis (1922 p. 221) in the following very suggestive way: »Chiefly important among these is the new view of evolution, first proposed by Guppy in 1906, and by the writer in the following year, that evolution did not proceed from individual to variety, from variety to species, from species to genus, and from genus to family, but inversely, the great families and genera appearing at a very early period, and subsequently breaking up into other genera and species.»

As to the mechanism of this differentiation-process, Guppy and Willis accepted mutations arising independently of the environment as the evident cause, and rejected both selection and »direct adaptation» as factors of any importance. Similar views are found in the works of Crampton (1917, 1925 *a*, *b*). As to isolation, none of these authors appears to have fully recognized its fundamental rôle in the differentiation-process. And probably there is not much need of isolation for the explaining of this differentiation-process, if we count with mutation to such an extent as these authors did — especially if with l a r g e mutations like those assumed by Willis — just as Darwin's strong belief in the great power of selection made him regard isolation as a factor of minor importance.[1]

[1] As has recently been pointed out by Ekman (1928, 1929), many recent geneticists have made a great mistake in accusing Darwin of having believed selection to be able to p r o d u c e new biotypes. The production of new biotypes forming the material for selection Darwin explained by non-induced mutation (»variation»), and to some extent (especially in his later works) by mutation induced by the environment. But certainly he believed in the power of selection to change a population by favouring even mutations differing in the most minute and insignificant characters from the main stock of the population — and in this belief he was followed by Wallace, Weismann and other selectionists of the Darwinian period. Therefore he thought himself able to explain the remarkable differentiation of species in the Galapagos Islands by the minute differences in the c o m p e t i t i o n f a c t o r s of the different islands, which he thought sufficient to lead to the favouring of different mutations in the different islands (even if the same mutations were produced in them all). However, he confessed that the lack of differences in the h a b i t a t of the different islands for a long time appeared to him as a great difficulty (Darwin 1859 p. 400). What a small rôle he alotted to the pure isolation-factor is clearly seen both in his publications (comp. for instance 1859 p. 402, 1869 pp. 119—122) and

Quite independently of Guppy and Willis, the differentiation-theory was advanced again in 1916 by Cajander (1916 pp. 561—562, comp. also 1921) and Lotsy (1916, comp. also 1912—1914). Cajander explained the differentiation-process partly (and apparently in first line) by selection, partly by mutation; he also pointed out that it resulted not only in geographical races and geographically vicarious species, but also in ecological races and ecologically vicarious species (»Standortsrassen» and »Standortsarten»). Lotsy, on the other hand, did not accept any mutation-theory, but explained the differentiation-process simply by isolation (spatial or physiological) in connection with selection. Similar views were expressed by Heribert-Nilsson (1918). Already in 1917 J. Schmidt had pointed out that besides selection »pure accidents» must be an important factor in the differentiation of local races in *Zoarces viviparus* (comp. above p. 349) But it was first Hagedoorn (1921) who showed the way to a real understanding of the differentiation of a syngameon by isolation even in the absence of any selection (and of any mutation), thus making the differentiation-theory quite independent of all the changing theories regarding the existence of effective selection as well as of induced or non-induced mutation.

During the last decade, the differentiation-theory has been accepted by several authors. Turesson (1922—1929) followed the same main channels of thought as Lotsy, J. Schmidt and Cajander, studying the differentiation of species into »ecotypes» (partly corresponding to Cajander's »Standortsrassen», partly to his geographical races, comp. also above p. 355) and explaining this differentiation mainly by selection. The present author (Du Rietz 1923 *a*) applied the same point of view upon the differentiation of species, pointed out the insufficiency of selection for its explanation, and, rejecting mutation as a probable factor of importance, emphazised

in his letters to Wagner (comp. Wagner 1889 p. 350, Romanes 1897 pp. 103—106). Under those circumstances it is important to note that in earlier years Darwin had expressed a much higher appreciation of the rôle of isolation; in 1844 he declared in a letter to Hooker, that »with respect to original creation or production of new forms... isolation appears the chief element» (Romanes 1897 pp. 101—102). Evidently this was the primary impression left by the field-studies of his youth, but under the influence of his later speculations and work with domestic animals and plants it gradually faded away and was replaced by the theory of natural selection.

the importance of purely accidental differences in the original composition of isolated parts of a syngameon. Among other recent contributors to the differentiation-theory, Berg (1926), Danser (1929 *a*, *b*) and Baur (1930 pp. 399—400) must be specially mentioned.

If we take the existence of this process of differentiation of a highly polymorphic syngameon into species as a fact — and I really think we have the right to do this now — we may leave the question of how those syngameons were originally formed provisionally open, and try to look into the possible bearing of this differentiation-process upon the practical delimitation of the taxonomical units superior to the species. In those cases where it is obvious and undisputable that a number of species have been differentiated out of one original syngameon, the desirability of uniting all those species to a unit of higher rank has been felt by several authors. If the differentiation is due only to geographical isolation, *i. e.* if a series of »vicarious species» (»echte Vikaristen» *sensu* Vierhapper 1919) with only one species in each of the isolated districts (islands, mountains etc.) is formed, those species form an »Artenkreis» in the sense of Rensch (1929) and a »Formenkreis» in the sense of Kleinschmidt (1901—1926), who does not recognize the difference between the two types of units separated by Rensch as »Artenkreise» and »Rassenkreise». A good example of a natural group of species of this type is formed by the three vicarious species of *Gentiana* in the subantarctic islands of New Zealand mentioned above (p. 364).

If the differentiation is due not only to geographical but also to ecological or physiological isolation, there is often not one species in each district corresponding to one species in each of the other districts, but a group of several nearly related species in each district corresponding to an analogous group in each of the other districts. In such a case I have mostly found Rensch's »Artenkreis»-concept unapplicable, as it is often impossible to say that one of those nearly related species in a certain district is more corresponding to a certain species in another district than the others. In the genus *Dracophyllum* in New Zealand, for instance (comp. Oliver 1928), there are only a few examples of clearly vicarious species forming distinct »Artenkreise» *sensu* Rensch (one of the best is that of the two tuft-tree species *D. recurvatum* in North Island and *D. Traversii* in South Island). But most of

the New Zealand species of *Dracophyllum* form a network of species combining certain characters in the most various ways, and occurring together in more or less overlapping distribution-areas in such a way that it is not possible to group them into distinct »Artenkreise», but only into dubious »Artenkreise» in several alternative ways. If, for instance, life-form and habitat are taken as base for the grouping, the subalpine dwarf-shrub heath species *D. recurvum* (in the central part of North Island, comp. above p. 373) and *D. pronum* (South Island) may be grouped to one »Artenkreis», while *D. filifolium* (one of the dominants of the North Island subalpine scrub, comp. above p. 373) forms another »Artenkreis» together with *D. rosmarinifolium* (= *D. uniflorum* of the older literature, one of the dominants of the South Island subalpine scrub). But if we take the leaves or the flowers as base, *D. recurvum* and *D. pronum* must be placed in quite different »Artenkreise», and the same will be the case with *D. filifolium* and *D. rosmarinifolium*. According to the position of the flowers (a character considered to be of great taxonomical importance in *Dracophyllum*), *D. rosmarinifolium* could also be united with *D. subulatum* (on the Volcanic Plateau of North Island) and some other species into an »Artenkreis» not less natural than the one mentioned above.

The method of grouping geographically vicarious species into »Artenkreise» appears thus to be applicable only in special cases. Another method is the grouping of the species forming hybrids fertile enough to allow »Vermischung» (exchange of genes) in nature or in cultivation, into one commiscuum in the sense of Danser (comp. above p. 387), and of the commiscua forming more or less sterile hybrids into one compariu m or »Bastardierungsgenossenschaft» (Danser 1929, *a, b*). The whole section *Lapathum* of the genus *Rumex*, for instance, according to Danser forms one comparium. And of the New Zealand species of *Nothofagus* four (*N. fusca, N. cliffortioides, N. Solandri* and *N. truncata*) probably form one commiscuum, while the fifth species (*N. Menziesii*) forms not only its own commiscuum but probably even its own comparium (comp. Cockayne 1926, Cockayne and Atkinson 1926).

Probably it will be found possible to work out a synthesis of the method last mentioned with the geographical method mentioned above, enabling us to reconstruct many of the old syngameons from which the present species have been differentiated. As a

matter of fact, many of the sections, subgenera and genera distinguished in present-day taxonomy, especially those with a rather restricted distribution, give the impression of being old well-defined syngameons split up into a number of species in the way described above.

It cannot be discussed here in any detail what rôle selection and induced or non-induced mutation[1] may have played during this differentiation-process. In the discussion above, I have only talked of the process of differentiation by means of automatic reduction of polymorphy, because no other process appears to be needed to explain what we see in nature, and because this is the only process about which we know anything with full certainty. But, as mentioned above (p. 353), this differentiation process may be supported by selection (or rather by heterogenous elimination), if the isolation takes place in obviously differing habitats. And it would be unscientific to deny the possibility that even induced or non-induced mutation may play a rôle in that process, though I must admit that I (like Lotsy, Heribert-Nilsson, Hagedoorn, Danser and other recent authors) am unable to find much talking in favour of this assumption. As to the rôle of selection, my field-experience in various parts of the world and in various groups of the vegetable kingdom has brought me to exactly the same conviction as that of Wagner (1868—1889), Guppy (1906—1917), Willis (1907—1923), Hagedoorn (1921), Hayata (1921—1928), Tower (1922), Lotsy (1925 *a*), Parr (1926), and many other authors, namely that the rôle of selection has been much overrated, and that it mainly consists of the elimination of biotypes absolutely unviable in a certain habitat (Du Rietz 1929 p. 422). Nobody has expressed this better than Lotsy (1925 *a* p. 59): »We have no evidence that it is the fittest, the best adapted, which

[1] The term »mutation» is used here to designate 1) any genotypical change, small or large, continuous or discontinuous, that is not due merely to recombination of genes, and 2) any new biotype produced by such a change. Especially in America that term is still sometimes used also in the sense of Burbanks, *i. e.* as a designation for biotypes originating from a cross and exhibiting characters not present in any of the parents (comp. Hagedoorn 1921 pp. 84—85, 154—155 etc.), or »extravagant» biotypes in the sense of Heribert-Nilsson (1918). Such appearing of new characters simply as the result of a recombination of genes (»Amphimutation» in the sense of Plate 1913 p. 497, 1914 p. 138) is not included in the mutation-concept used here (which corresponds only to Plate's »Neo- oder Idiomutation»).

survives in the struggle for life; all we can say is that it is the survivals which survive, and this is probably, just as in a railway accident, more determined by a happy position than by any particularity of structure.» A critical study of the correlation between life-form and habitat in various parts of the world has made me believe that this correlation is much overrated in botanical literature, and that only life-forms absolutely unviable in a certain habitat are eliminated in this habitat, while chance and historical factors, but not superior or inferior adaptation, mostly determine the main composition of the vegetation (Du Rietz 1929 p. 422) — just as is the case in the human population! This certainly speaks neither in favour of the theory of positive selection nor of that of mutations partly induced by the habitat. But to all those problems I hope to come back in another publication.

As to the rôle of hybridization in the differentiation of syngameons into separate species, we unfortunately know very little. Evidently it must often happen, that the differentiation-process is counteracted by the occasional meeting and crossing of two species spatially — geographically or ecologically — isolated, but still belonging to the same commiscuum (*e. g. Veronica longifolia* and *V. spicata,* comp. above p. 377) — or *Abies alba* and *A. cephalonica*, which according to Mattfeld (1930) were geographically differentiated from a common stock during the Tertiary period but brought together again by the Glacial period, producing the highly polymorphic hybrid *A. Borisii regis* now connecting the *A. cephalonica*-population of Greece with the *A. alba*-population of the northern Balkan Peninsula). Equally clear is that this must often give rise to »extravagant» forms, and even that some of them — as well as some of the more intermediate forms — may happen to become isolated and then be vital enough to develope into new species.[1] It is quite clear, that the actual polymorphy

[1] The theory of species-production by means of hybridization can be traced back as far as to Linnæus, who already in 1744 (Peloria) expressed the belief that new species, and even genera, could be formed by hybridization. In 1760 (De sexu plantarum) he advanced the theory that there had originally been only one species in each genus, all the other species being formed by the crossing of that species with species belonging to other genera. (A good summary of the genetical views of Linnæus, which were fundamentally different from those ascribed to him in most of the evolutionistic and genetical literature, is given by Almquist 1917). — In 1820 W. Herbert, on the base of extensive hybridization-experiments, expressed the view that the present species of each main

of a commiscuum may be heightened in this way, but not its potential polymorphy (comp. Danser 1929 *b*), and all the new forms produced in this way may very well have been rea-

group of plants had »been produced by variation of soil, temperature, or humidity», and »that such diversity might have been further multiplied by hybrid intermixture, as the species were brought together by the natural progress of their diffusion» (Herbert 1820 p. 17). Later on, the hybridization-theory has been repeatedly advanced by many authors. Already in 1863 Ch. Naudin, who had expressed similar views himself as early as 1852 (comp. Focke 1881 pp. 505 and 509), wrote that »plusieurs botanistes d'une grande autorité croient que certains hybrides fertiles, sinons tous, peuvent se fixer et passer à l'état de variétés constantes, c'est-à-dire de véritables espèces» (Naudin 1863 p. 196); among those botanists E. Regel was specially mentioned. In 1871, A. Kerner published his first essay on the formation of species by hybridization, and in 1881, he and L. Reichenbach were mentioned as the chief advocates of this theory by Focke (1881 p. 506), who also believed, that »ein grosser Theil der neuen Arten zwar nicht plötzlich, aber doch mittelbar aus Racenkreuzungen hervorgeht» (p. 509). In 1891 (and 1898), Kerner gave a more complete account of his »Vermischungstheorie» stating that »alle in der Nachkommenschaft sich erhaltenden Veränderungen der Gestalt durch Kreuzung, beziehentlich durch Vermischung zweier ihrer Konstitution nach verschiedener Protoplasten zu stande kommen» (Kerner 1898 p. 536). — In recent literature Weismann is often mentioned as one of the originators of this theory — Wiesner (1902 p. 259) even talks of »die Weismann-Kerner'sche Vermischungstheorie». This appears to be in bad accordance with the following passage in Weismann's last work (1913 II p. 304): »Einzelne Botaniker, wie Kerner v. Marilaun, sehen in der Vermischung der Arten ein Mittel zur Bildung neuer Arten mit besseren Anpassungen; sie lassen fruchtbare Bastarde unter Umständen die Stammarten verdrängen und selbst zur Art werden. Man wird zugeben können, dass solche Fälle vorkommen ... aber man wird dennoch behaupten müssen, dass die Artbildung im grossen und ganzen auf anderen Wegen erfolgt als durch Bastardierung. Solche Fälle sind wohl ohne Zweifel nichts anderes als seltene Ausnahmen.» In some of his earlier works, however, Weismann had attempted to make amphimixis (or »Vermischung») responsible for all »the material of individual differences through which selection produces new species» (Weismann 1886 p. 29, comp. also 1891 p. 135), a position also accepted by Wallace (1889 p. 439). But in this connection hybridization between different species was never mentioned, only »Vermischung» between slightly differing individuals of the same species. And with his logical mind Weismann realized later on, that by such »Vermischung» alone it would hardly be possible to explain the evolution in which he — contrary to Kerner — believed so strongly. On p. 175 in his last work (1913, part II) he clearly declared, that he did not regard amphimixis as »die eigentliche Wurzel der Variationen selbst», but considered evolution possible only by »Umbildung, Verkümmerung und Neubildung von Determinanten», *i. e.* by mutation. — During the last two decades the hybridization-theory has got a very able and energetic advocate in Lotsy (1912—1929), who has gone further than any of his predecessors, attempting to explain evolution exclusively by means of

lized in the original commiscuum before the differentiation of the species concerned (comp. Heribert-Nilsson 1918 p. 141). — It is also known that new commiscua may be accidentally formed by the crossing of biotypes belonging to separate commiscua within the same comparium (Karpetschenko 1928, Danser 1929 *b* pp. 424—425). In the light of recent geneticists' successful production of polyploid biotypes by crossing (comp. for instance Winge 1917, 1926 *b*, 1928, Rosenberg 1928, Renner 1929) it appears rather probable that the polyploid species found in many genera may have been produced by crossing of different commiscua during the process of differentiation of the syngameon originally formed by the genus concerned (though it also looks quite possible that they have been present in the syngameon from the beginning of its existence). In this way the potential polymorphy of certain commiscua may be accidentally heightened during the differentiation-process. But as crossing between different comparia is absolutely excluded, the potential polymorphy of a comparium can never be heightened, only reduced (Danser 1929 *b* pp. 427—428). As a comparium only rarely includes more than one good genus, this implies that most genera (or at least genera not connected by hybrids with any other genus) can never heighten their potential variability, but only reduce it.

This view appears to be supported by the fossil evidence available in several plant-genera, *e. g.* in *Fagus* and *Quercus*. Only the example offered by *Fagus* will be discussed here. The *Fagus*-population of the Tertiary period apparently formed one widely distributed and very polymorphic syngameon (*Fagus Feroniae* Ung., comp. Ettingshausen 1894, Stojanoff and Stefanoff 1929, etc.), containing all the forms of the present *Fagus*-species but dominated by other forms only appearing accidentally in the present *Fagus*-populations (»atavistic forms» in the sense of Ettingshausen and Krašan 1888—1889, comp. also Krašan 1888). By isolation and reduction of polymorphy this highly polymorphic syngameon has become differentiated into the less polymorphic present species

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hybridization. This was never attempted by Kerner, who did not believe in evolution, but only in »einer Umgestaltung, einer Umprägung des Vorhandenen» (1898 p. 536, comp. below p. 407). To this view also Heribert-Nilsson (1918 p. 143) returns, accepting the rest of Lotsy's theory, but declining the theory of evolution as impossible to reconcile with the results of modern genetics. Comp. also the theory of Hayata reviewed below (pp. 405—410).

of Europe, Western and Eastern Asia, and North America, but still the characters of the dominating Tertiary forms as well as those of the other present species may crop up accidentally in some of those species. Nothing appears to be talking in favour of the assumption of a Post-Tertiary »evolution» in this genus, neither by crossing nor by mutation. If all the *Fagus*-populations now isolated in Europa, Asia, and America were brought together again into one large syngameon, it appears rather probable that we would get back much of the a c t u a l polymorphy of the Tertiary *Fagus*-population — but the p o t e n t i a l polymorphy of the genus would remain just the same, and would probably prove much lower than that of the Tertiary population.

The difficulties in reconstructing the old syngameons, from which the present species may have been differentiated and into which they may be naturally grouped, are rapidly increasing as we get along to genera or units of still higher rank. According to the very suggestive theory of Lotsy (1916, comp. also Du Rietz 1921 p. 90), each main class of animals and plants originally formed one vast syngameon (originating from an accidental cross of widely differing biotypes of an older syngameon), but even if this be true, the reconstruction of the whole process of differentiation of those immense syngameons of decreasing size appears anyhow to be a rather hopeless task. Our division of the main classes of animals and plants into orders, families, genera etc. must therefore to a large extent be carried out in the rather artificial way of grouping the species, genera etc. simply after their morphological resemblance. The same method must often be used even for the grouping of the species within a genus, at least until the commiscua and comparia within that genus have become sufficiently known. The more this purely morphological method can be combined with geographical, paleontological, genetical and cytological methods, the greater is the chance that it will ultimately be possible to reconstruct the old syngameons within the group concerned.

According to current opinion among taxonomists and morphologists of the present day, this morphological method of delimiting taxonomical units of higher rank should be founded upon the theory of d i v e r g e n t e v o l u t i o n, *i. e.* the taxonomical units should be delimited and arranged according to their supposed p h y l o g e n y. In this p h y l o g e n e t i c m e t h o d o f t a x o n o m y a central rôle is played by the distinction between »Organisationsmerkmale» and »Anpassungsmerkmale» (Nägeli 1884). To

the first group (also called »indifferent» or »constitutional» characters) are referred characters supposed to have arisen independently of the environment [by some sort of »Vervollkomnungsprinzip» (Nägeli 1884) or »Orthogenesis» (Haacke 1893, Eimer 1897)], to the latter group (= the »epharmonic» or »adaptive» characters of many authors[1]) characters supposed to have arisen as »adaptations» to a certain environment. Taxonomical units of higher rank are allowed to be founded only upon the former group of characters. If two species are found to have a character of this type in common (*e. g.* a floral or especially an embryological character) this is taken as a proof of their phylogenetical relationship, and they are placed in the same genus, family etc. But if two species are found to have a character of the second type in common (*e. g.* life-form, bud-type, or leaf-type), this is said to be a case of »epharmonic convergence» and is considered to be of no taxonomical importance whatever.

This distinction — and with it the whole »natural» plant-system of the present day — of course stands or falls with the theory of an evolution by means of mutations partly induced, and partly not induced, by the environment. To this main theory belong all the various evolution-theories of Darwin, Nägeli, and modern neolamarckists of selectionistic or anti-selectionistic type. Even in the theory of evolution only by means of selected non-induced mutations (*i. e.* the pure selection-theory of Weismann, comp. above p. 401), it is hard to conceive how that distinction could be upheld strictly. And in the theory of »evolution by means of hybridization» there is certainly no room for it at all; according to Lotsy (comp. also Heribert-Nilsson 1918 p. 135, Du Rietz 1921 p. 90) phylogeny is a mere illusion, »no science but a product of phantastic speculation» (Lotsy 1916 p. 140) — and certainly nobody could be more competent a judge in this question than Lotsy, who has devoted a considerable part of his life to the reconstruction of phylogeny after orthodox lines. It is just the same in the anti-evolutionistic succession-theory of Hayata and his predecessors (Kerner etc., comp. below p. 407). But as practically all the leading botanical taxonomists of the last half century have strongly believed in the theory first mentioned, all that has been of no moment whatever.

[1] Both those terms are sometimes used also for p h e n o t y p i c a l characters (comp. Diels 1921 p. 137, Cockayne and Allan 1927 pp. 263—267). These, of course, do not concern us here.

Considering the attitude of intense distrust taken by most geneticists of the present day towards the theory of mutations induced by the environment, the method of making this theory a fundament of higher botanical taxonomy may be called at least a rather dangerous one. And this will still more be the case, considering that the doubts of the geneticists are supported by the results of ecological field-studies. As was mentioned above (p. 400), my own comparative field-studies of life-forms, bud-types, leaf-types etc. in widely differing parts of the world have brought me to the conviction that such characters — belonging to the typical »epharmonic characters» (or »Anpassungsmerkmale») of orthodox taxonomy — are mostly far less correlated with the environment than generally believed. Certainly this does not speak in favour of their formation by means of mutations induced by the environment. The material upon which those statements are based cannot be presented here, but I hope soon to have it ready for publication.

A most remarkable revolt against the traditional phylogenetic method of taxonomy was started about a decade ago by B. Hayata (Professor at Tokyo Imperial University and Director of the University Botanic Gardens), whose imposing taxonomical knowledge and wide field-experience of tropical, subtropical, and temperate vegetation certainly ought to make European botanists read his contributions (Hayata 1921 *a*, *c*, 1928 *a*, *b*, *c*) with greater attention than appears to have been the case until now. But certainly they are revolutionary enough to make an orthodox phylogenetical taxonomist shudder. Some extracts of Hayata's works will probably be the best way to demonstrate the main views of this remarkable reformator.

»As I stated in the preceding paper, I have been reflecting on a system of natural classification to which my attention was drawn during the score of years that I devoted to the study of the flora of Formosa. Current opinion demands that such a natural system be a static one like Bentham-Hooker's or Engler's and that there is possible only one true ideal system, to which, however, we are as yet far from attaining, as but one phylogenetic tree is possible. Much against my will, I have come to entertain strong doubts as to the effectiveness of the modern systematizers' effort to attain the ideal system; and my twenty year's experience in systematic botany has steadily led me into quite a different

channel of thought. This I now venture to make public, though I am aware that it will meet with a great deal of opposition.

All systematizers regard the natural system as a static one with a definite form and believe that all species, genera or families have their fixed natural positions, so as to be arranged between this and that, according to their natural relations. My idea is quite different from this current opinion. I regard the natural system as a dynamic one, changing with the view of the systematizer and subject to alteration, according to the way in which it is considered, and I believe that none of the species, genera or families has a fixed natural position, but has changeable positions, subject to alteration according to the criterion for comparison. It is neither natural nor necessary that a species should in all cases be arranged between this limit and that; but should be placed between this and that according to one view, or between another this and another that according to another view. In the present paper, it is my desire to explain what I propose to call the dynamic system showing the natural relations of plants.» (Hayata 1921 *b* pp. 97—99.)

Hayata strongly objects against the orthodox view that only two main theories about the origin of species are possible, namely the theory »that all the species are created by God separately and independently» and the theory »that all the species are formed by evolution from a single origin», *i. e.* the evolution theory. He points out that there is »one more way possible for the formation of species», namely that »an innumerable number of species of organic beings have existed from the eternal past and will exist to the eternal future; they unite with or separate from one another, and produce many different organisms by different combinations of the genes; or they change by themselves, as the genes change» (Hayata 1921 *a* p. 94). To this theory Hayata gives the name of the participation theory[1], and explains the theory more fully in the following way:

[1] To the first part of this theory Hayata later on (1928 *a*) gave a separate name, namely »the succession theory». While the participation-theory *sensu stricto* appears to be possible to reconcile with the evolution-theory in the form given to it by Lotsy, the succession-theory stands in clear opposition to any form of the evolution-theory. According to the evolution-theory, the organic population of the present day has been produced by divergent evolution, starting with very primitive organisms and successively proceeding to higher ones. According to the succession-

»The theory is in fact but one theory, yet for convenience' sake I shall treat it as two, namely: — The theory of the mutual participation of the gene, and the theory of the mutual sharing of the gene. Literally speaking, the word 'participation' seems to express a united action of genes to produce a certain result. Different

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theory, on the other hand, a divergent evolution from lower to higher organisms has not been proved, but only a succession without progression, and there is no reason to believe that the original organic population of the earth was less manifolded and of a »lower» type than the present one. — Like the hybridization-theory (comp. above p. 400), this theory can be traced back as far as to LINNÆUS, who believed in the transformation of species, and to some extent even of genera, by means of hybridization (comp. above p. 400), but certainly not in any evolution. Similar views were widely spread among the botanists of the first half of the last century — in spite of the traditional tale of evolutionistic literature, that botanists before DARWIN believed that all the present species were unchangeable, simultaneously created by God independently and separately. In 1820, W. HERBERT (comp. above p. 400) formulated the theory »that in the early periods of the world, there existed only the distinct genera of plants, or heads of families, not, however, exactly according to the present divisions of Botanists; who indeed, are perpetually at variance with each other, as to the features which are sufficient to constitute a variety, a species, or a distinct genus. The lapse of centuries and diversity of soil and climate have probably wrought the most wide and permanent distinction between vegetables, that have originated from a common stock, possibly even between the arborescent Ferns of the Andes, and the herbaceous inhabitants of our forests.» (HERBERT 1820 p. 16; this theory is mentioned by DARWIN in the historical introduction to the later editions of his »Origin of species».) In 1852 ELIAS FRIES — one of the leading botanical taxonomists of his time — wrote that »we now know with full certainty, that many quite different vegetation-periods have succeeded each other on earth, not a single one of our present species thus being original, but all of them being, as was observed already by the prophetic eye of LINNÆUS, *the daughters of the time* ('filia temporis')» (E. FRIES 1852 pp. 189—190. But like LINNÆUS, FRIES was inclined to accept the genera as original (pp. 191—193), and certainly never believed in any progressive evolution. Of Post-Darwinian authors clearly opposing the evolution-theory, A. KERNER takes the foremost place. His »Vermischungstheorie» (comp. above p. 401), first published in 1891, certainly comes nearer the views of HAYATA than any other previous theory: »Sie setzt voraus, dass von jeher zahlreiche verschiedene Pflanzenformen nebeneinander bestanden haben, was durch die fossilen Reste auch tatsächlich bestätigt wird. Was sich von Pflanzen aus früheren Perioden erhalten hat, weist durchgehends darauf hin, dass zu allen Zeiten eine grosse Mannigfaltigkeit von Pflanzenformen die Erde bevölkerte. Es bedurfte daher keiner Entwickelung, sondern nur einer Umgestaltung, einer Umprägung des Vorhandenen.» (KERNER 1898 p. 536.) However, KERNER never drew the taxonomical consequences of those views drawn by HAYATA, nor did he oppose the theory of natural selection.

genes participate in the effort to produce the resulting plant or plant organ. Different plants or plant organs on the other hand are found to share in the work of certain genes, or combinations of genes; or perhaps we may say that the word 'participation' points to the future, while the word 'sharing' points to the work accomplished in the past. Thus, different genes participate in the work of producing a certain result, while different plants share with one another the work of certain genes. It must be admitted, however, that my theory does not necessarily agree with that used in genetics, but is rather to be regarded as the latter theory expanded to the utmost limit.» (HAYATA 1921 *b* pp. 101—102.)

»All individuals alike possess innumerable genes or factors. The former present various phenomena according as, on the one hand, the latter are potent or latent; and on the other, according to the different combinations or segregations of potent genes. Consequently, the relation of one individual to the others in phenomenal appearance is the relation of mutual participation or sharing of potent and latent genes in individuals.

Then, too, all genes in individuals may be apparent at one time and latent at another, and may change their characters, according to conditions. As genes change, so change individuals. Yet, no new gene is ever created or produced; no existent gene ever vanishes. The genes now present are those that have existed from the eternal past and will continue to exist throughout the infinite future.» (HAYATA 1921 *b* pp. 102—103.)

»As for mankind, and especially for any one human family, a genealogy is the history of descent from an ancestor. The customary manner of making up a genealogy for a family is to trace its history through descent on the father's side, only one side being taken into consideration, if not the father's, then the mother's. Thus, a genealogy is usually considered to be something like a tree with spreading branches, the ancestor being here compared to the trunk, and the descendants, to the branches. It is clear that this graphical method is altogether useless when descent through both parents is taken into consideration.» (HAYATA 1928 *b* p. 1869.)

»From the Participation Theory, it follows now that it becomes, in any case, impossible to admit the existence of a single or a few forms of a particular nature ancestral to the innumerable

species which at present we have. Ancestors should (in their phenomenal appearances) be as different from one another as are their descendants. These forefathers, varying in different ways, presumably by crossing, one being succeeded by another, must have given way to the species of the present day. Even supposing ancestors to have been much simpler than their descendants and more resembling one another, they must have potentially been sufficiently different to succeed to one generation after another.» (Hayata 1928 *c* p. 1883).

The practical application of »the dynamic system» is demonstrated by Hayata by the following general introduction:

»Now, turning back our attention to what we have said before of the natural classification, we now see that our first attempt in the course of the latter is to find how species share their genes with others. Then, the second attempt is to group species into small or large groups according to the extent with which they have shared their genes with others [Lotsy, P. J. — Evolution by Means of Hybridization (1916) pp. 137—138], — into groups which should be subject to alteration, as to their limits as well as their members, according to whether we select this or that gene as a criterion for classification, — simply speaking, into dynamic groups. Finally, our third attempt is to arrange the dynamic groups thus obtained, such as species, genera or families, according to the relations of the mutual sharing of genes, — to arrange them, not in a fixed order, but in orders varying with views, or simply speaking to arrange them in a dynamic manner. The arrangement in dynamic forms is what I have spoken as a dynamic system. I shall explain it with examples further on.

Now, let us take four individuals representing four different species. These four are composed of numerous different genes; but amongst the latter genes only four, represented symbolically by **a, b, c** and **d,** are so far known to us. We shall try to systematize these species. Let a gene in parentheses denote a latent gene. Then, the four species may be symbolized as follows: — **(a)bcd, a(b)cd, ab(c)d** and **abc(d).** One way of classifying these four is to group them into two groups, one containing the latent **(a)** gene and the other, the potent **a** gene. There are more three different ways of making up such groups of the same category by substituting **(b)** (**c**) or (**d**), in the place of (**a**). Also, there are certainly many other ways of grouping the four species so as

to classify the species by taking a combination of genes as a criterion instead of a single gene, such as **ab, cb, ac, bc, cd,** or **bcd, acd, abd, abc,** and so forth, — each way being in agreement with a natural relation according to each respective view. So the groups themselves are changeable or dynamic, according to whether we take this gene or that, or this combination or that, as a criterion for classification. One way of grouping can not be said to be more natural than others. Any one is natural so far as it is understood as dynamic and changeable according to views. But as soon as it is understood to be the only fixed, unchangeable one, admitting no other way, it becomes unnatural.» (HAYATA 1921 *b* pp. 105—106).

After this introduction HAYATA demonstrates his principles more in detail by presenting a »dynamic system of natural classification applied to the Angiosperms, with ENGLER's system as a framework.» (HAYATA 1921 *b* pp. 159—216). Everyone of ENGLER's orders and families is put in the centre of those families to which, according to HAYATA, it shows a distinct relationship. As to this practical application of the system, however, I must refer the reader to the original treatise.

I have quoted HAYATA's work to such a length because his views appear to have been unduly overlooked by most present-day taxonomists [the only reference to them that I have seen is the reviews of KRAUSE (1922 *a*, *b*) and a few words by CROW (1926)], and also because those views are very similar to those in which my own field-experience has resulted. When I learnt to know HAYATA's works in 1929, I was really surprised to find how my own field-experience, culminating in my voyage around the world in 1926—1927, had brought me to views in many respects identical with those expressed by HAYATA several years earlier (DU RIETZ 1929 pp. 421—422). I am mentioning this because I fully realize what opposition those views will meet, and because I must take it as a good sign that they have crystallized independently in the minds of two botanists with wide field-experience in widely differing parts of the world's vegetation.

When my own field-studies had brought me to the conviction that the »epharmonic characters» (»Anpassungsmerkmale») did not show the high degree of correlation with the environment postulated in orthodox taxonomy and ecology, I could not help drawing the conclusion that the method of founding the higher taxo-

nomical units only upon the traditional »Organisationsmerkmale» could not be maintained. The conflict with the traditional system arising from this consideration brought me to try various alternatives for the grouping of the species in certain genera. During those attempts I discovered some remarkable regularities in the geographical distribution of various characters. Studying the New Zealand flora, for instance, I found that in the genus *Celmisia* brown and yellow hairs showed a remarkable frequency in the northern part of South Island, being found there in species widely differing in other respects (*C. Traversii*, *C. cordatifolia*, *C. Macmahoni*, *C. Dallii*, and *C. hieracifolia*), but of much rarer occurrence in other parts of New Zealand. In the genus *Dracophyllum* similar regularities were found (comp. above p. 398): terminal panicles or racemes are found in many species of the northern and central part of North Island (from the small dwarf-shrub species *D. recurvum* to the big tuft-tree species *D. latifolium*, *D. recurvatum* etc.) but only in one species of South Island (*D. Traversii*) and in no species at all in the southern part of South Island, where lateral panicles or racemes are characteristic even in the large-leaved tuft-tree species *D. fiordense* (comp. Oliver 1928). In the genus *Euphrasia* I found that digitate leaves (a character found in all the South American species of that genus but very rare elsewhere) were characteristic for several species (rather different in other respects) of the southern part of South Island, but in the rest of the Australian-New Zealand region only occured in one Tasmanian species (comp. Wettstein 1896 *b*), *i. e.* that this South American character was found in widely differing species only in the parts of Australasia geographically most related to South America. In the same genus I found certain life-forms concentrated to certain parts of New Zealand, where they could impossibly be correlated with a certain climate, but in those parts appearing in the most different groups of the genus (just the same if those groups were founded upon the flowers or upon the leaves). — To all those regularities (and many others that cannot be mentioned here) I could not find any other possible explanation than that in the syngameon originally formed by each of those genera, certain genes had been generally distributed only in certain districts, but in those districts had »infected» the whole population. In this respect there was no difference whatever in the behaviour of »Organisationsmerkmale» and »An-

passungsmerkmale» in the traditional sense. But if »epharmonic characters» could behave in this way within a certain genus, it did not then look impossible that they could do the same also in larger populations, *i. e.* that many cases of »epharmonical convergence» could be explained simply by the accidental distribution of a certain gene in the whole population formed by a certain family, order or even class in a certain region already at the time when this population formed one vast syngameon.

Just the same point of view may be applied to the many examples known of »Vavilov's law of homologous variation» (comp. above p. 346). If homologous forms appear in species belonging to quite different genera or families, why may not this simply be the result of the presence of the same gene in all those forms? For nearly related species this explanation already appears to be generally accepted among geneticists (comp. Philiptschenko 1927). But as soon as we come to species belonging to different higher units of the traditional system, Philiptschenko finds its impossible to apply this theory of »genotypical parallelism», postulating a principially different »morphological parallelism», »auf deren Eigentümlichkeiten der Begriff der Gene und der genotypischen Struktur überhaupt nicht anwendbar ist» (Philiptschenko 1927 pp. 74—75.) As an intermediate type of parallelism Philiptschenko accepts the »oecotypical parallelism», which »bald von gleichen, bald auch von völlig verschiedenen genotypischen Strukturen abhängen kann» (l. c.). As a result of this negative attitude towards the explanation of the »morphological parallelism» Philiptschenko finds it possible to explain only »the evolution of biotypes, jordanons and linneons», or the »micro-evolution» in the light of modern genetics, while he considers »the evolution of higher taxonomical groups» or »macro-evolution» to lie completely »ausserhalb ihres Gesichtsfeldes» (pp. 93—94). May be he is right, but certainly my own experience makes me more inclined to follow Hayata in looking for the explanation also of »morphological parallelism» in genotypical resemblance.

Of course we must not forget that it is not allowed to translate »character» into »gene». We can only see the characters but not the genes, and a certain character is supposed to be the result of the coaction of an immense number of genes, all of which are necessary for the formation of the character. The disappearing of a certain character may thus be the result of the lack of quite

different genes in different cases, and vice versa (comp. for instance Johannsen 1913 pp. 666—667, and especially the very clear discussion by Hagedoorn 1921). The matter looks still more complicated in the light of Goldschmidt's (1920, 1928) theory of quantitative gene-differences. Future research must show to what extent those difficulties may be overcome in practical taxonomy. Theoretically we may attempt to follow the suggestion of Hayata to found the higher units of taxonomy upon the distribution of genes, but practically it looks quite possible that we will still have to be content with founding them upon the distribution of characters. Anyhow, the main reform that is needed in higher taxonomy certainly is that we will have to take genotypical characters as they are without any subjective valuation, neither in »Organisationsmerkmale» and »Anpassungsmerkmale» nor in »progressive» and »regressive» characters. And here Hayata certainly is right both in pointing out that every natural system must form a network and not a phylogenetical tree,[1] and in rejecting the idea of one single static system.

My main objection against the principles of Hayata is that I think he is underrating the taxonomical importance of the lines or zones of discontinuity formed in the series of biotypes by geographical, ecological or physiological isolation. As has been the main purpose of this paper to show, I think that the fundamental units of taxonomy should be founded just upon those lines or zones of discontinuity, and the purely morphological grouping taken as a refuge first when we proceed to populations of higher rank in which that method is failing. I am also more inclined than Hayata to leave the question open whether »no new gene is ever created or produced» and whether »no existent gene ever vanishes». How life originated on earth »in the eternal past» we shall probably never know, nor how it will develop or if it will even exist »in the eternal future».

But with those restrictions (and perhaps some others of minor importance), I feel convinced that the participation theory and the dynamic system of Hayata will prove a most excellent working-base for the great reform of higher botanical taxonomy that is so greatly needed. I cannot refrain from citing in this connection the following critical remarks made by Krause in his review of

[1] Diels (1921 pp. 187—189) has also pointed out, that the relationship of plants is far better illustrated by a network than by the traditional phylogenetical tree.

Hayata's first work on those subjects, because they give the best characteristic possible of the prejudices dominating present taxonomical botany:

»Die angeführten Proben zeigen, dass Verf. einmal Analogien, wie z. B. Anordnung der Blüten in Kolben, erikoide Blattgestalt, ähnliche Fruchtentwicklung, Kleinheit der Samen usw. als Grundlagen für die Annahme einer natürlichen Verwandtschaft ansieht. ... Denn nicht selten hat man den Eindruck, als ob Verf. rein äusserliche, vielleicht nur durch gleiche Lebensverhältnisse bedingte Ähnlichkeiten, wie Blattform, Sukkulenz oder dergleichen, auf eine Stufe stellt mit anderen wesentlichen Merkmalen im Blütenbau, wie Beschaffenheit und Stellung der Samenanlagen usw.» (Krause 1922 *a* p. 51).

I do not think that the fundamental difference between the view of Hayata and myself and that of traditional taxonomy could have been expressed better. For my own part, it is just in the raising of those neglected »epharmonic characters» (or »Anpassungsmerkmale») to the same taxonomical rank as that so long monopolized by the floral characters only, that I see the only way to an unprejudiced study of the higher taxonomical units. But Hayata's excellent idea of the dynamic system certainly ought to make it possible for old and new systems to exist in friendship side by side in future taxonomy.

Plantbiological Institution of Upsala University, June 25th, 1930.

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Postscript.

During the printing of this paper there has appeared a new paper of N. Heribert Nilsson (Sind die mutierenden reinen Linien auch rein?, Hereditas, Bd. XIV, H. 1, Lund 1930), containing such importants results and views that I cannot refrain from adding a few words about them. By extensive cultures Heribert Nilsson has found that different individuals of a certain so-called »pure line» of oats produce pure lines differing considerably in their production of »mutations», some of them giving a much higher percentage of mutations than others. From this result Heribert Nilsson draws the conclusion that the original »pure line» did not contain only homozygous individuals, thus being no real pure line at all, and that the »mutations» appearing in it

(and in analogous false pure lines) are no real mutations but simply some sort of »segregants» caused by the heterozygosity. This certainly does not speak in favour of the current theory of the rapid production of pure (*i. e.* homozygotic) lines by autogamous reproduction (comp. above p. 339). On the contrary, it gives a strong support to Lotsy's recent doubting of the existence of a n y absolutely homozygotic biotype in nature even in »pure lines» (comp. above p. 341). This implies that the existence of real pure lines in nature may be a mere illusion, and that the taxonomical importance of the pure line-concept thus would be still smaller than postulated above (p. 339).

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ZUR EMBRYOLOGIE DER SAXIFRAGOIDEEN.

VON

K. V. OSSIAN DAHLGREN (UPPSALA).

Vor einem Jahrzehnt hat mein Freund, der jetzige Professor in Zürich, Dr. E. Gäumann eine Untersuchung über die embryologischen Verhältnisse einiger Saxifragazeen in unsrem Institut angefangen. Ich habe ihm dabei mein fixiertes Saxifragazeen-Material überlassen. Er hat auch die Resultate seiner Studien teils in zwei Vortragsreferaten (1918, 1920) teils in einem Aufsatz in Recueil des travaux botaniques néerlandais (1919) veröffentlicht. Er hat aber nunmehr jede weitere Bearbeitung dieser Pflanzen aufgegeben und mich seit Jahren aufgefordert, meine einmal geplanten Untersuchungen wieder aufzunehmen. Nach Rückkehr von seiner Anstellung in Java hat er mir auch freundlichst einige leider wenig gelungene Fixierungen sowie auch einige alte Zeichnungen von *Peltiphyllum peltatum* geschickt. Verschiedene Beschäftigungen haben mir jedoch erst vorigen Sommer erlaubt, die Arbeit zu beginnen. Selbstverständlich habe ich meine Aufmerksamkeit hauptsächlich auf die Endospermverhältnisse gerichtet. Schon die musterhafte Arbeit von Juel (1907) über *Saxifraga granulata* hatte besonders zu Studien hierüber angetrieben; und die wichtigsten Ergebnisse Gäumanns sind gerade auf dem Gebiet der Endospermentwicklung zu finden.

Meine bisher ausgeführten Untersuchungen gelten vorzugsweise die Unterfamilie *Saxifragoideae* und waren eigentlich für einen Vortrag bei der fünften internationalen Botanikerversammlung in Cambridge bestimmt. Es zeigte sich aber, dass das Programm derselben schon vollgezeichnet war. Ich möchte doch jetzt meine

Untersuchungen mitteilen, da es wahrscheinlich ziemlich lange dauern wird, ehe ich Gelegenheit bekomme, sie wieder aufzunehmen. Dann hoffe ich auch andere Unterfamilien behandeln zu können. Eine vorläufige Mitteilung ist in Svensk Bot. Tidskrift für dieses Jahr erschienen.

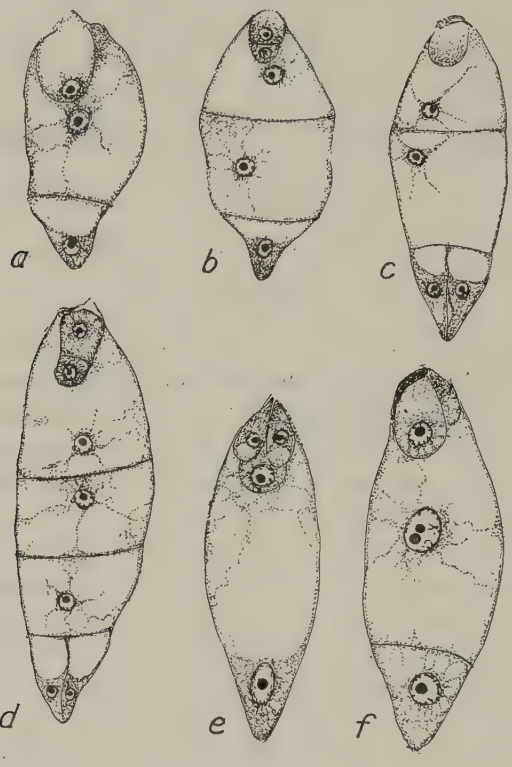

Fig. 1. *a—d Astilbe rivularis* und *e—f A. grandis*. Entwicklung des Endosperms. — Vergr. 280.

I a. Saxifrageae: Astilbinae.

Astilbe.

Astilbe japonica. Bei Webb (1902, S. 457) findet man einige kurze Notizen über die Entwicklung des Embryosackes bei »*Spiraea*» *japonica*, d. h. *Astilbe japonica* (Rehder 1902, S. 246), der überall gezüchteten Zierpflanze. Von der Endospermentwicklung, die uns hier besonders interessiert, hat er nicht viel zu sagen. Er bildet den oberen Teil eines Embryosackes mit einem ziemlich jungen

Embryo sowie auch einigen freien Kernen ab (S. 459), »which surround or clings to the embryo at this stage». Leider enthält mein Material keine geeigneten Stadien dieser Pflanze, was sehr zu bedauern ist, da ich bei zwei anderen Arten einen anderen Endospermtypus festgestellt habe.

Astilbe grandis. Fig. 1 *e* zeigt einen fertigen Embryosack mit dem primären Endospermkern im Chalazaende. In Fig. 1 *f* hat sich nach der ersten Kernteilung eine basale Endospermzelle abgetrennt. Diese wird durch eine Wand der Länge nach geteilt, die obere grosse durch eine Querwand. Das Endosperm bleibt also von Anfang an zellular.

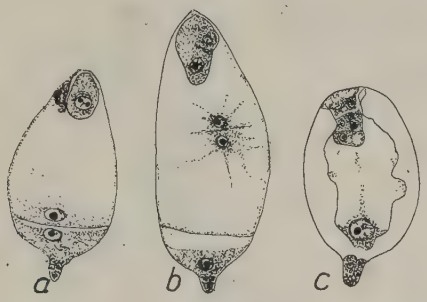

Fig. 2. *a—b Heuchera cylindrica.* Endospermbildung. — Vergr. 175. — *c Heuchera sanguinea.* Der Embryosackkern hat sich noch nicht geteilt, trotzdem ein vierzelliger Embryo vorhanden ist. (Nach Gäumann.)

Der Embryosack — wie auch die Eizelle selbst — hat in reichlicher Menge eine stärkeartige Substanz, die, wenigstens in fertigen Mikrotompräparaten, die auf gewöhnliche Weise behandelt sind, von Jodjodkalium rötlich gefärbt wird. Bei der vorhererwähnten Art hat Webb Stärke konstatiert. Selbst habe ich bei derselben Pflanze die Embryosäcke ganz mit typischen Stärkekörnern vollgepfropft gesehen. Bei mehr als fünfzig Pflanzenfamilien ist Stärke im Embryosack gefunden worden, was aus einer von mir zusammengestellten Übersicht hervorgeht (Dahlgren 1927).

Astilbe rivularis und *A. simplicifolia.* Die Entwicklung dieser Pflanzen ist in der Hauptsache der der vorhergehenden ähnlich. Fig. 1 *a* zeigt also den Embryosack in eine grössere und eine kleinere Zelle geteilt, und Fig. 1 *b, c* und *d* einige folgende Stadien in der Entwicklung des Endosperms.

Heuchera.

Heuchera sanguinea. Die Endospermentwicklung dieser Art ist von GÄUMANN (1919, S. 288) studiert. Zwar spricht er eigentümlicherweise von *Heuchera* »*purpurea*», aber ich weiss, dass er *H. sanguinea* fixiert hat.

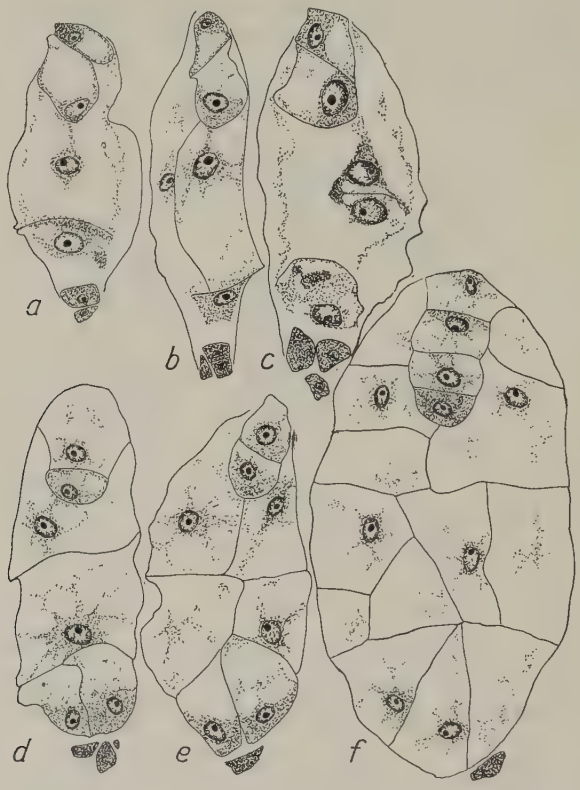

Fig. 3. *a—f Peltiphyllum peltatum.* Verschiedene Stadien der Endospermbildung. In *b* ist der obere Teil des Embryosackes durch eine Längs- in *c* durch eine Querwand geteilt. — Vergr. 200.

Der primäre Endospermkern, der immer an der Basis des Embryosackes liegt, teilt sich, wobei ein zweizelliges Endosperm von demselben Typus wie bei *Astilbe* zustande kommt. Die erste Teilung sowohl in der kleinen basalen als auch in der grossen mikropylären Kammer ergiebt Längswände als Resultat. Nur ausnahmsweise — in zwei Samenanlagen — hat GÄUMANN gesehen, dass auf die erste Kernteilung in der mikropylären Kammer eine Querwand folgte.

Heuchera cylindrica (Fig. 2), die ich untersucht habe, verhält sich in der Hauptsache wie die eben erwähnte Art. Jedoch ist zu bemerken, dass auf die erste Kernteilung der mikropylären Kammer eine Querwand folgt (Fig. 2 *b*) — wenigstens in allen denjenigen Embryosäcken, die ich untersucht habe, was bei vorhergehender Art nur ausnahmsweise der Fall sein soll. Vier Tetradzellen entstehen, von denen die basale den Embryosack bildet.

Peltiphyllum.

Peltiphyllum peltatum. Wie schon gesagt habe ich von Gäumann einige hier reproduzierte Zeichnungen (Fig. 3) erhalten, die eine Entwicklung ähnlich wie die der vorher genannten Pflanzen zeigen. Die erste Teilung der mikropylären Kammer kommt offenbar entweder durch eine Quer- (Fig. 3 *c*) oder eine Längswand (Fig. 3 *b*) zustande. Die Figuren bedürfen übrigens keiner weiteren Erklärung.

Tellima.

Tellima grandiflora zeigt eine ähnliche Entwicklung. Vier Tetradzellen sah van der Elst (1909, S. 13). Die untere Tetradzelle bildet den Embryosack. Mehrmals habe ich sog. Synergidenhaken beobachtet, was schon Pace (1912, Fig. 86, S. 311 u. 318) bei drei Saxifragazeengattungen konstatiert hat. (Über derartige Bildungen siehe übrigens meinen Aufsatz über »Hakenförmige Leistenbildungen bei Synergiden» vom Jahre 1928.) Der primäre Endospermkern liegt im Basalteil des Embryosackes, wie es bei allen hierhergehörigen Pflanzen der Fall ist. Nach seiner ersten Teilung entstehen wie gewöhnlich eine kleine basale und eine grössere mikropyläre Zelle. Nächstfolgende Teilung ergibt in der basalen Zelle eine Längswand und in der anderen eine Querwand.

Saxifraga.

Saxifraga granulata ist wie gesagt eingehend von Juel (1907, S. 21) untersucht worden. Er hat hier das Vorhandensein eines sog. *Helobiae*-Endosperms festgestellt, d. h. unmittelbar nach der Teilung des primären Endospermkerns entstehen zwei Zellen, eine kleine oberhalb der Antipoden und eine grössere, die den übrigen Teil des Embryosackes einnimmt. Diese Zelle erzeugt freie Kerne vor der Zellbildung. In der basalen Kammer entstehen schliesslich etwa acht Zellen. In meiner Arbeit vom Jahre 1923, S. 13

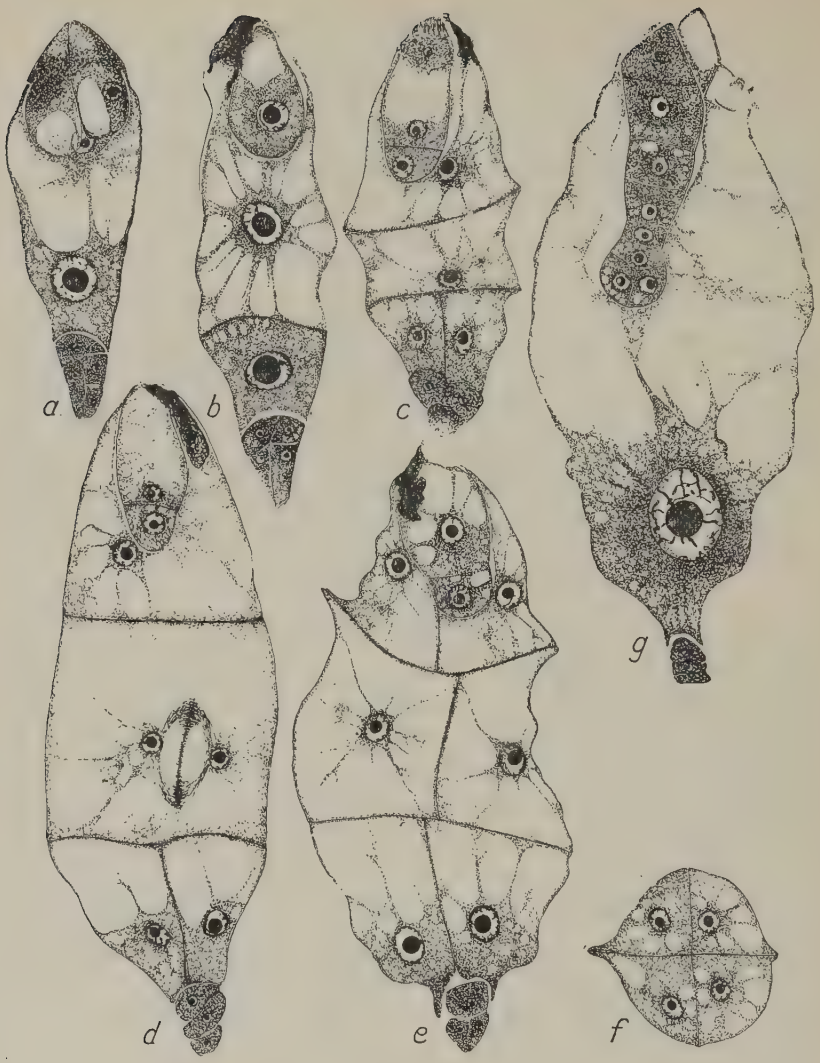

Fig. 4. *a—g Mitella pentandra.* *a* Unbefruchteter Embryosack. — *b* Eine basale Endospermzelle abgeschieden. — *c* 4-zelliges Endosperm. — *d* Eine neue Zellteiluug findet statt. — *e* 8-zelliges Endosperm (nur zwei Zellen im Basalteil sichtbar). — *f* Querschnitt durch das basale Endosperm eines Embryosackes wie in *e*. — *g* Ein Embryo ist vorhanden, aber der sekundäre Embryosackkern ist ungeteilt geblieben. — Vergr. 415.

habe ich zwei nicht früher reproduzierte Photographien der Endospermentwicklung dieser Pflanze mitgeteilt. In einem Vortragsreferat teilt Gäumann (1918, S. 269) mit, dass *Saxifraga aizoides*

bis über 20 freie Kerne in der basalen Kammer und in reifen Samen ein etwa 300 Zellen zählendes basales Endosperm hat. Samuelsson (1913, S. 131) erzählt nebenbei, dass *Helobiae*-Endosperm ausser bei der letzterwähnten Art auch bei *Saxifraga Cymbalaria, S. Hirculus, S. oppositifolia* und *S. tridactylites* vorhanden ist. Bei dem Bastard *Saifraga decipiens* × *granulata* hat Schürhoff (1925, S. 448) in bezug auf die Endospermbildung »die für *Saxifraga*-Arten typischen Bilder» gefunden. Selbst habe ich bei *Saxifraga rotundifolia* die ersten Teilungen nicht gesehen, aber Präparate mit einigen basalen Zellen und im übrigen freien Endospermkernen deuten wohl auf denselben Entwicklungsgang bei dieser Art hin.

Chrysosplenium.

Chrysosplenium alternifolium und *Chr. tetrandrum* sind von Gäumann studiert, und er hat die Endospermentwicklung, die von Eichinger fehlerhaft beschrieben war, richtig dargestellt. Die Entwicklung des Endosperms gestaltet sich im Grossen genommen nach demselben Schema wie bei der Gattung *Saxifraga*. In der basalen Kammer gibt es bei *Chrysosplenium alternifolium* wenigstens acht freie Kerne, ehe eine Zellbildung eintritt. Im Basalteil des Endosperms können in reifen Samen rund 50 Zellen vorhanden sein, die man immer noch unterscheiden kann, weil der Inhalt dieser Zellen homogener ist. Nachdem bei *Chrysosplenium alternifolium* ein zweizelliger Embryo entstanden ist, teilt sich die der Mikropyle am nächsten liegende Zelle durch eine Längswand. Die beiden auf diese Weise entstandenen Zellen vergrössern sich kräftig und werden plasmareich. Eichinger hat sie für Synergiden gehalten, was Gäumann (1919, S. 301) als fehlerhaft nachgewiesen hat.[1]

Mitella.

Mitella pentandra entwickelt vier Tetradzellen. Zuweilen ensteht ein sog. T-Tetrad. Der Embryosack zeigt das für hierhergehörige Pflanzen typische Aussehen mit dem primären Endospermkern in der Nähe der Antipoden. Die Synergiden haben auch solche

[1] Schon der von Eichinger und Gäumann nicht angeführte Hegelmaier (1886, S. 546) hat sich dasselbe Missverständnis zuschulden kommen lassen. Einen ähnlichen Suspensorstypus wie bei *Chrysosplenium* haben wir auch bei einigen anderen Pflanzen nämlich bei *Hypecoum procumbens* (Guignard 1903) — früher auch von Hegelmaier missdeutet — *Laurembergia javanica* (Bley 1925, S. 25) und *Myriophyllum alterniflorum* (Stolt 1928, S. 315).

Fig. 5. *a—f Mitella diphylla. a* Embryosack mit noch ungeteiltem Endospermkern. — *b* Teilungen im zweizelligen Endosperm. — *c* 4 freie Kerne im oberen Endospermteil und 4 Zellen, wovon nur zwei sichtbar sind, im unteren Endosperm. — *d* Späteres Stadium, fortwährend Zellbildung nur im Basalteil. — *e* und *f* Junge Embryonen. — Vergr. 280.

Leistenbildungen wie die vorher für *Tellima grandiflora* erwähnten (Fig. 4 *a*).

Fig. 4 *b* zeigt ein zweizelliges Endosperm. Nach darauffol-

gender Teilung bildet sich in der kleineren und plasmareicheren basalen Zelle eine Längswand und in der grösseren mikropylären eine Querwand (Fig. 4 *c*). In allen vier Endospermzellen finden dann Teilungen der Länge nach statt (Fig. 4 *d*, *e* und *f*). Das Endosperm ist also durchweg zellulär.

Fig. 4 *g* zeigt uns einen Embryosack, in welchem offenbar nur das Ei aus irgend einem Grunde befruchtet worden ist. Ein Embryo ist vorhanden, der sekundäre Embryosackkern ist aber immer noch ungeteilt. Er ist wie man sieht stark vergrössert und liegt fortwährend in der basalen Plasmaanhäufung. Der Embryosack hat auch an Grösse zugenommen, ist aber doch nicht grösser als der in Fig. 4 *e* abgebildete, dessen Embryo nur zweizellig ist. Die übrigen Embryosäcke aus demjenigen Fruchtknoten, der den in Fig. 4 *g* abgebildeten Embryosack enthielt, waren ungefähr doppelt so breit und bedeutend länger. Noch einige ähnliche Fälle von ausgebliebener Endospermbildung sind von mir (1927, S. 208) und Schnarf (1929, S. 318) mitgeteilt. Gäumann (1919) bildet einen Embryosack von *Heuchera sanguinea* (»*purpurea*») mit einem vierzelligen Embryo und einem ungeteilten sekundären Embryosackkern ab (Fig. 2 *c*). Er schreibt (l. c., S. 289): »Es kann nun ausnahmsweise vorkommen, dass aus unbekannten Gründen der befruchtete Embryosackkern sich erst sehr spät teilt und dass ihm die Eizelle in der Entwicklung vorauseilt, wie dies in Fig. 6 dargestellt ist.» Ich glaube jedoch, dass Gäumann einen Fall von ausgebliebener Doppelbefruchtung bei dieser Pflanze angetroffen hat.

Mitella diphylla zeigt im Vergleich zu vorhergehender Art sehr bemerkenswerte Verhältnisse. Der Embryosack ist vom gewöhnlichen Typus (Fig. 5 *a*), und die Folge der ersten Teilung des primären Endospermkerns ist wie gewöhnlich, dass sich eine Querwand dicht oberhalb der Antipoden bildet (Fig. 5 *b*). In der also gebildeten Basalkammer finden auch in der Fortsetzung Zellbildungen statt (die zwei ersten Zellen habe ich jedoch nur einmal gesehen), aber in der grossen mikropylären Kammer entstehen freie parietal gelegene Kerne. Fig. 5 *c* ist nach einem Embryosack gezeichnet, der vier basale Endospermzellen und vier freie Kerne (von denen jedoch nur zwei Zellen und zwei freie Kerne am Bilde sichtbar sind) sowie auch einen zweizelligen Embryo einschloss. Eine andere Samenanlage enthielt einen vierzelligen Embryo (Fig. 5 *e*), acht freie Endospermkerne und vier basale Zellen. Ein

älteres Stadium wird in Fig. 5 *d* dargestellt. Innerhalb einer und derselben Gattung haben wir also zwei verschiedene Endospermtypen.

Der Embryo hat ein recht eigentümliches Ausschen. Wie aus Fig. 5 *d, e* und *f* hervorgeht, verdickt sich der Suspensorsteil durch Zellteilungen.

Boykinia.

Boykinia occidentalis. Diese Pflanze und *B. tellimoides* sind gewissermassen dem Paare *Mitella pentandra* und *M. diphylla* parallel. Fig. 6 *a* zeigt einen Embryosack von *Boykinia occidentalis* mit dem sekundären Embryosackkern am gewöhnlichen Platz. In Fig. 6 *b* hat sich die basale Zelle abgetrennt und wird bald durch eine Längswand geteilt (Fig. 6 *c*). Auch in der grösseren Endospermkammer finden Zellteilungen statt (Fig. 6 *d*). (Das Material von den beiden *Boykinia*-Arten stammt vom botanischen Garten in Gotenburg.)

Boykinia tellimoides. Bei dieser Art ist die Entwicklung wie gesagt eine andere. Der Embryosack ist auffallend breit (Fig. 6 *e*). Bei der ersten Teilung des primären Endospermkerns trennt sich wie gewöhnlich eine kleine basale Zelle ab (Fig. 6 *f*). In der Fortsetzung entwickeln sich, wie aus Abbildung 6 *g* hervorgeht, freie Kerne.

Tolmiea.

Tolmiea Menziesii ist es mir leider nicht gelungen näher zu untersuchen, da diese Pflanze in unsrem Garten nicht fruktifiziert. Die Vererbung der Selbststerilität derselben ist sehr eigenartig und alleinstehend. Jedes Kind setzt nämlich mit seinen beiden Eltern an, und jedes Kind mit jedem anderen Kinde gleicher Herkunft wie Correns (1928) erwiesen hat.

In seiner Arbeit finden wir (S. 760) einige kümmerliche Notizen, die Fr. v. Wettstein, damaliger Assistent Correns', geschaffen hat: »In einem Fruchtknoten, der nach 46 Stunden fixiert worden war, war in vielen der ganz normalen, 8-kernigen Embryosäcke die Befruchtung schon eingetreten, wenige waren im Befruchtungsstadium, einer zeigte schon einen Embryo. Nach 3 Tagen wiesen alle Samenanlagen lebhafte Embryo- und Endospermbildung auf». Das ist alles. Ich kann nur wenig hinzufügen, da die mir von Professor Correns freundlichst übersandten Pflanzen noch nicht

zu Blüte gekommen sind. Vier Tetradzellen entstehen, zuweilen T-förmig angeordnet. Bisweilen »keimen» mehr als eine von den Tetradzellen. Ich habe also zwei Kerne in der basalen Zelle und ihrer Schwesterzelle gesehen, ebenso wie in der basalen und in der dritten Zelle. Der Embryosack ist vom gewöhnlichen Typus.

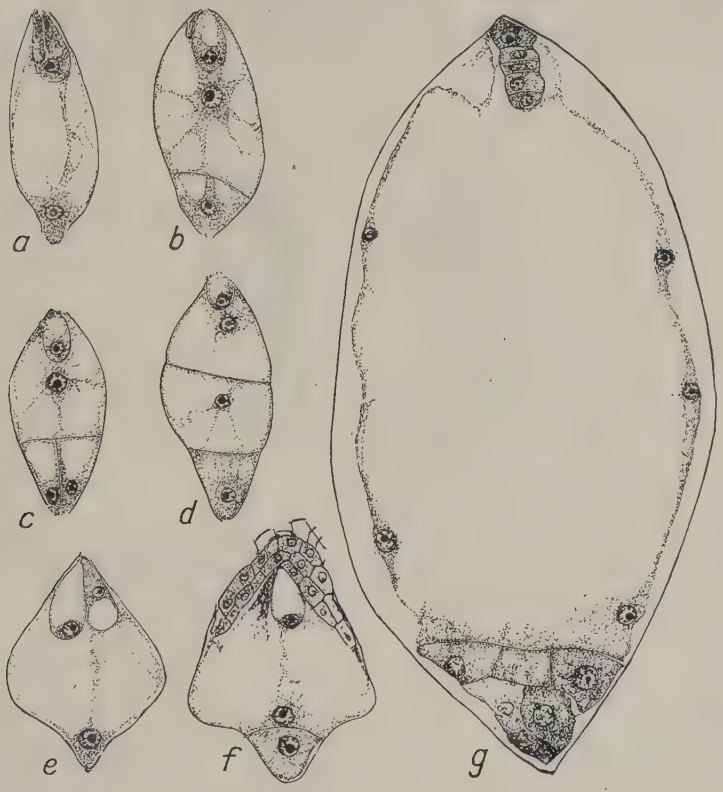

Fig. 6. *a—d Boykinia occidentalis.* Die Endospermbildung ist durchweg zellular. *e—g Boykinia tellimoides.* Nach der ersten Teilung des primären Endospermkerns wird eine kleine basale Zelle abgetrennt (*f*). In dem übrigen Teil des Embryosackes findet anfangs nur freie Kernteilungen statt (*g*). — Vergr. 280.

II. Francoeae.

Francoa appendiculata und die sehr nahe verwandte *Fr. ramosa* hat Gäumann studiert. Es entsteht eine reichliche Bildung von freien Endospermkernen, die die Wände des ganzen Embryosackes bekleiden. Der basale Teil desselben frisst sich stark in Nuzellus hinein, wodurch der Embryosack hier erweitert wird. Wenn der

ganze obere Teil des Embryosackes mit einem inhaltsreichen Zellgewebe erfüllt ist, sind im Basalteil noch wandständige freie Kerne zu finden (Fig. 7 *a*). Jedoch tritt später auch hier Zellbildung ein (Fig. 7 *b*), wodurch ein Gewebe mit lockrerem Zusammenhang der Zellen und geringerem Eiweissgehalt entsteht. Dieser Basalteil des Endosperms ist jedoch nur transitorisch und wird später vom oberen persistenten Endospermteil verdaut.

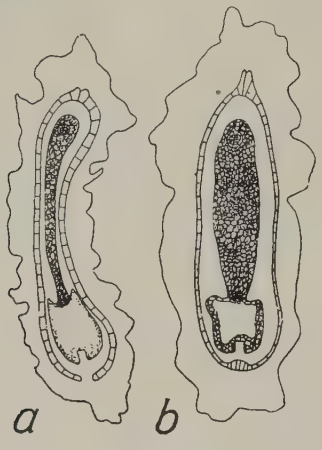

Fig. 7. *a—b Francoa appendiculata*. *a* Der obere Endospermteil ist zellular, der untere erweiterte Teil noch mit freien Kernen. — *b* Zellbildung ist auch im Basalteil angefangen. (Nach Gäumann.)

III. Ribesieae.

Ribes rubrum **silvestre* M. & K. ist die einzige Art dieser Gattung, mit der ich mich bisher besonders beschäftigt habe. Einige kurze Mitteilungen über Bau und Entwicklung des Embryosackes bei *Ribes*-Arten haben folgende Forscher gemacht: Hofmeister, Vesque, Warming, Fischer, Guignard, Tischler, van der Elst (1909) und Himmelbaur (1912).

Der Embryosack bei *Ribes rubrum* hat das für die Saxifragoideen gewöhnliche Aussehen. Der primäre Endospermkern liegt also zum Schluss dicht oberhalb der Antipoden (Fig. 8 *a*). Diese befinden sich in einem postamentartigen Vorsprung. Denselben Embryosacktypus habe ich bei *Ribes divaricatum*, *R. multiflorum* und *R. niveum* gesehen. Er ist übrigens bei *Ribes aureum* von Tischler (1903) und bei *Ribes pallidum* (*R. petraeum* × *rubrum*) von Himmelbaur (1912, Fig. 18 und 19) abgebildet.

Deutliche Synergidenhaken besitzt *Ribes rubrum* (Fig. 8 *a*). — Bei dieser Pflanze habe ich einmal zwei Embryosäcke nebeneinander gesehen sowie auch einmal zwei Nuzelli, ein jeder mit eigenem innerem Integument aber mit einem gemeinsamen äusseren. Diese letzte Erscheinung hat auch TISCHLER (1903, S. 413) bei dem Bastard *Ribes Gordonianum* beobachtet.

Über die Endospermbildung bei *Ribes*, die uns hier besonders interessiert, liegen keine Angaben[1] vor. Die erste Teilung des Endospermkerns ist von Zellbildung gefolgt, wodurch eine kleine

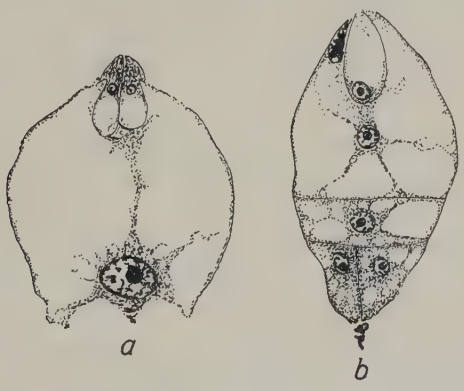

Fig. 8. *a—b Ribes rubrum *silvestre* M. & K. *a* Fertiger Embryosack. — *b* Eine kleine basale Endospermzelle, die sich später durch eine Längswand geteilt hat, ist zuerst abgetrennt. In dem übrigen Teil des Embryosackes hat eine Querteilung stattgefunden. — Vergr. 280.

basale Zelle abgetrennt wird. Diese wird nachher in zwei nebeneinander stehende Zellen und der übrige Endospermteil durch eine Querwand geteilt (Fig. 8 *b*). *Ribes multiflorum* scheint auch ein zellulares Endosperm zu besitzen, obwohl ich nicht die ersten Stadien beobachtet habe.

* * *

[1] Zwar gibt SCHNARF (1929, S. 375) in seinem Handbuch an, dass HIMMELBAUR nukleares Endosperm beobachtet hat. HIMMELBAUR (1912, S. 234) bemerkt jedoch selbst, dass er die Bildung des Endosperms nicht verfolgen konnte. — Eine andere Kleinigkeit in der vorzüglichen Arbeit von SCHNARF (S. 377) möchte ich auch berichtigen. Ich habe die Endospermbildung bei *Plumbago capensis* und *Ceratostigma plumbaginoides* nicht verfolgen können, da bisher diese beiden heterostylen Pflanzen bei uns keine Früchte gebildet haben. Ich bedaure, dass meine Ausdrucksweise nicht genug deutlich gewesen ist. — Für das Endosperm von *Myrsine africana* und *Maësa indica* hat SCHÜRHOFF (1926, S. 643) in seinem Handbuch angegeben, dass ich den zellularen Typus beobachtet habe. Das ist jedoch irrtümlich. Ich habe in der zitierten Abhandlung gerade das Gegenteil gesagt.

Im Vorstehenden haben wir die Unterfamilie *Saxifragoideae* in derselben Umfassung genommen, die ihr Engler (1930) neulich gegeben hat. Er hat die früheren Unterfamilien *Francoideae* und *Ribesioideae* zu Tribus unter *Saxifragoideae* degradiert, dagegen aber eine neue Unterfamilie *Parnassioideae* von den Saxifragoideen abgetrennt.

Vom embryologischen Gesichtspunkt aus ist dagegen kaum etwas einzuwenden. Bei *Parnassia* ist die Embryosackmutterzelle in dem unbedeutenden Nuzellus syndermal wie bei *Escallonia* und *Philadelphus,* während sämtliche untersuchte Saxifragoideen dagegen Deckzellen abtrennen, d. h. apodermal sind. (Über die Nuzellusmorphologie und deren systematische Bedeutung siehe Dahlgren 1927.)

Ferner hat der befruchtungsfertige Embryosack bei hier behandelten Pflanzen ein recht charakteristisches Aussehen. Der sekundäre Embryosackkern liegt nämlich nicht in der Nähe des Eiapparates, wie es so oft der Fall ist, sondern weiter unten im Embryosack manchmal dicht oberhalb der Antipoden. Wenigstens kurz vor der ersten Teilung nimmt der primäre Endospermkern immer eine ausgesprochen basale Lage ein und wird von einer verhältnismässig reichlichen Plasmamenge umgeben, wie aus mehreren hier mitgeteilten Figuren[1] hervorgeht. Die ziemlich isoliert stehende Gattung *Francoa* bildet vielleicht eine Ausnahme. Nach Gäumann (1919, S. 306) findet man nämlich zur Zeit der Befruchtungsreife den sekundären Embryosackkern an den Eiapparat angelehnt »oder irgendwo im freien Raum» des Embryosackes. Leider habe ich *Francoa* nicht selbst untersucht. Es wäre doch von einem gewissen Interesse zu wissen, ob sich die erste Teilung des primären Endospermkerns auch hier im Basalteil des Embryosackes abspielt.

Die Endospermbildung scheint vielleicht zuerst keinen systematischen Wert für die Saxifragoideen zu haben. Wir finden ja, um nun die eingebürgerten Ausdrücke zu verwenden, sowohl den nuklearen als auch den zellularen und den *Helobiae*-Typus vertreten wie aus folgender Übersicht hervorgeht:

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[1] Ausser bei vorher genannten Pflanzen habe ich die basale Lage des primären Endospermkerns bei *Bergenia crassifolia, Heuchera americana, Tiarella trifoliata, T. cordifolia* und *Boykinia aconitifolia* gefunden.

Nukleares-	Helobiae-	Zellulares-Endosperm
(*Astilbe japonica*??)	(*Astilbe japonica*?)	*Astilbe grandis*
Francoa appendiculata	*Saxifraga granulata*	» *rivularis*
» *ramosa*	» *aizoides*	» *simplicifolia*
	» *Cymbalaria*	*Heuchera sanguinea*
	» *Hirculus*	» *cylindrica*
	» *oppositifolia*	*Peltiphyllum peltatum*
	» *tridactylites*	*Tellima grandiflora*
	» *decipiens* × *granulata*	
	» *rotundifolia* (?)	
	Mitella diphylla	*Mitella pentandra*
	Boykinia tellimoides	*Boykinia occidentalis*
	Chrysosplenium alternifolium	*Ribes rubrum* **silvestre*
	» *tetrandrum*	» *multiflorum* (?)

Wie ich schon vorher betont habe (Dahlgren 1923, S. 12, 1924, S. 195), ist die Endospermbildung der Saxifragoideen indessen bedeutend einheitlicher, als diese Tatsachen zuerst an die Hand zu geben scheinen. Die charakteristische Lage des primären Endospermkerns im Embryosack wird, allen Verschiedenheiten zum Trotz, gerade von der im Prinzip ziemlich gleichartigen Endospermbildung bedingt.

Die ziemlich freistehende Gattung *Francoa*, die wie gesagt neulich von Engler unter die Saxifragoideen eingeordnet worden ist, hat ein nukleares Endosperm[1]. Wenn dies als Wandbelag den ganzen Embryosack bekleidet, tritt die basale Partie durch ihre stärkere Färbbarkeit ziemlich auffällig hervor. Dieser Teil erweitert sich und führt immer noch lauter freie Kerne, wenn im übrigen Endosperm schon längst ein Zellgewebe vorhanden ist.

Bei allen übrigen näher untersuchten Saxifragoideen trennt sich unmittelbar nach der Teilung des primären Endospermkerns eine kleine basale Zelle von dem übrigen Embryosack ab. In der Fortsetzung können nun freie Kerne in beiden Zellen entstehen. In der basalen Zelle beobachten wir also bei *Saxifraga aizoides* etwa 20, bei *Chrysosplenium alternifolium* 8 (Gäumann 1918, S. 269) und bei *Saxifraga granulata* (Juel 1907, S. 21) 4 freie Kerne vor

[1] Wie erwähnt hat Webb bei *Astilbe japonica* den oberen Teil eines Embryosackes mit einigen freien Kernen abgebildet. Ob hier tatsächlich ein rein nukleares Endosperm oder — was vielleicht wahrscheinlicher ist — ein *Helobiae*-Endosperm oder ganz einfach eine fehlerhafte Beobachtung vorliegt, kann ich nicht sagen, da ich keine Endospermstadien dieser Pflanze besitze. Ich beabsichtige doch, sobald ich geeignetes Material bekomme, die Sache einer erneuten Prüfung zu unterziehen.

der Zellbildung. Bei *Mitella diphylla* habe ich keine freien Kerne in der Basalkammer gesehen, wohl aber einmal zwei Zellen. Im übrigen Endosperm sind freie parietal liegende Kerne zu sehen. Hier haben wir also eine interessante Modifikation des gewöhnlichen *Helobiae*-Typus. Und schliesslich erhalten wir den »rein» zellularen Typus bei *Heuchera, Peltiphyllum, Ribes* u. a., wo Zellbildungen sofort einsetzen sowohl in der kleinen basalen als auch in der grossen mikropylären Kammer.

Wir können eine schöne Serie von dem nuklearen Tupus über Helobientypen zum zellularen Endospermtypus zwangslos konstruieren (siehe Fig. 9). Die Verhältnisse bei *Francoa* stehen zwar ein bisschen isoliert, aber sonst ist die Endospermbildung bei den Saxifragoideen im Prinzip recht charakteristisch, die Einzelheiten mögen sich nun auf die eine oder andere Weise ausgestalten. In-

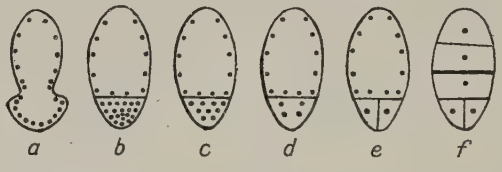

Fig. 9. Schema der Entwicklung des Endosperms: *a Francoa appendiculata; b Saxifraga aizoides; c Chrysosplenium alternifolium; d Saxifraga granulata; e Mitella diphylla; f Heuchera cylindrica.*

nerhalb derselben Gattung finden wir ja sowohl den *Helobiae*- als auch den zellularen Typus vertreten.

Ich habe vorher betont, dass das Abgrenzen eines besonderen Teils des Embryosackes — es mag nun bei der ersten Teilung des primären Endospermkerns oder später stattfinden — hauptsächlich mit trophischen Verhältnissen zusammenhängen dürfte. Aus meiner Arbeit (1924, S. 196) zitiere ich: »Es tritt eine Arbeitsverteilung ein zwischen dem Hauptendosperm und demjenigen Teil, der in erster Linie den grösseren Teil des Nahrungsstromes bekommt. Bei vielen zellularen Endospermen ist ebenfalls, wie gesagt, die Entwicklung der beiden ersten Zellen des Endosperms verschiedenartig. Bei nuklearen Endospermen ist es auch sehr gewöhnlich, dass sich das Endosperm im basalen Teil anders verhält (spätere oder ausbleibende Zellteilung, hypertrophiierte Kerne) als im übrigen Embryosack.»

Mehrere verschiedene und sehr interessante Formen von Endospermentwicklung kennen wir auch bei den Familien *Hydrophylla-*

ceae, *Borraginaceae*, *Solanaceae* und *Liliaceae* besonders durch die Arbeiten von Svensson[1] (1925 u. 1926) und Stenar (1928), Arbeiten auf die ich hier verweisen muss, weil ein Referat zu viel Platz in Anspruch nehmen würde. Die üblichen Ausdrücke nuklearer-, zellularer- und *Helobiae*[2]-Typus genügen nicht immer, wie ich vorher betont habe, um die Endospermbildung hinreichend zu bezeichnen. Es gibt auch andere Typen als diese zuerst beschriebenen. Ein tieferer Unterschied zwischen den verschieden etikettierten Typen braucht ja auch nicht immer zu bestehen.

Zum Schluss will ich auch erwähnen, dass *Penthorum sedoides* von Rocén (1928) untersucht ist. Diese Pflanze wird zuweilen zu den Crassulazeen gerechnet. Neulich hat Engler sie als eine besondere Unterfamilie unter den Saxifragazeen gestellt. Nach Rocén (l. c., S. 374) trennt sich zuerst eine kleine basale Endospermzelle ab. Alle folgenden Teilungen sind auch von Zellbildung begleitet. Ganz kürzlich ist eine Revision der embryologischen Verhältnisse bei den Crassulazeen von Mauritzon (1930) erschienen. Es zeigt sich, dass das Endosperm bei *Penthorum* eine von allen Crassulazeen abweichende Entwicklung durchläuft, was in systematischer Hinsicht ein gewisses Interesse darbietet. — Schliesslich möchte ich erwähnen, dass *Parnassia palustris* ein nukleares Endosperm besitzt.

Zusammenfassung.

1. Einige Vertreter der Unterfamilie *Saxifragoideae* (in der neuen erweiterten Fassung Englers 1930) werden besonders hinsichtlich

[1] Eine kleine Bemerkung nebenbei. Svensson (1925, S. 153) meint, dass die Grösse und Zuwachsschnelligkeit des Embryosackes nie irgend welche Rolle für die Art der Endospermbildung spielt. Das ist vielleicht etwas zu viel gesagt. Er schreibt u. a.: »Weiter können die Embryosäcke bei nahe verwandten Arten gleiche Grösse und Form besitzen, und doch entwickelt sich das Endosperm in diesen bisweilen nach verschiedenen Grundtypen. Schöne derartige Beispiele liefern die *Phacelia*-Arten.» Betrachten wir aber seine Figuren von Embryosäcken, zeigt sich doch z. B. *Phacelia congesta* (zellular) in einer viel stärkeren Vergrösserung gezeichnet zu sein als *Ph. tanacetifolia* (nuklear), was gerade gegen die Ansicht des Verfassers sprechen sollte. Ich bin daher froh mitteilen zu können, dass die Vergrösserung aus Versehen fehlerhaft angegeben worden ist.

[2] Der sog. *Helobiae*-Typus ist nicht für die ganze Reihe *Helobiae* kennzeichnend. Siehe meine Alismatazeen-Arbeit (Dahlgren 1928, S. 13)!

der interessanten Endospermbildungsverhältnisse untersucht. Wenigstens nach den bisher vorliegenden Ergebnissen zu urteilen sind die Resultate ziemlich einheitlich und können — allen Variationen zum Trotz — als für diese Pflanzen bezeichnend angesehen werden.

2. Zwei Integumente und eine apodermale (Deckzellbildung) Embryosackmutterzelle kommen bei allen vor.

3. Bei der freistehenden Gattung *Francoa*, die früher eine eigene Unterfamilie bildete, haben wir nach Gäumann ein nukleares Endosperm. Der erweiterte Basalteil des Embryosackes hat hier immer noch freie Kerne, wenn der übrige Teil schon längst mit Endospermgewebe erfüllt ist, und wird schliesslich verdrängt.

4. Bei allen übrigen untersuchten Arten trennt sich nach der ersten Teilung des primären Endospermkerns — immer im Chalazateil des Embryosackes liegend — eine kleine basale Zelle ab.

5. In dieser sowie im übrigen Endospermteil können nachher freie Kerne entstehen, ehe Zellbildung stattfindet (sog. *Helobiae*-Typus) wie bei mehreren *Saxifraga*- und zwei *Chrysosplenium*-Arten, *Boykinia tellimoides* und *Mitella diphylla*. (Bei dieser letzterwähnten entstehen sofort Zellen in der Basalkammer.)

6. Bei einer Anzahl von Arten (*Mitella pentandra*, *Boykinia occidentalis*, *Astilbe grandis* und *A. rivularis*, *Heuchera sanguinea* und *H. cylindrica*, *Peltiphyllum peltatum*, *Tellima grandiflora* und *Ribes rubrum* **silvestre*) bilden sich in der Fortsetzung Zellen sowohl in der grossen mikropylaren als auch in der kleinen Basalkammer aus. Die letztgenannte teilt sich immer durch eine Längswand.

7. Bei den Saxifragoideen leitet der sog. *Helobiae*-Typus zwangslos in den zellularen Typus über. Siehe das Schema in Fig. 9!

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ÜBER DEN VERWANDTSCHAFTSKREIS DER MYOSOTIS VERSICOLOR (PERS.) J. E. SM.

VON

T. VESTERGREN †.

Dieser Verwandtschaftskreis, den man auch sehr gut mit dem von Ascherson und Graebner verwandten Terminus Gesamtart bezeichnen könnte, umfasst nach meiner Erfahrung 5 verschiedene Typen. Zwei von ihnen sind gelbblütig und werden von mir als besondere Arten aufgefasst, *Myosotis lutea* (Cav. p. p.) Hoffmannsegg & Link und *M. Balbisiana* Jord. Die drei übrigen mit farbenwechselnder Krone führe ich aus unten näher zu erörternden Gründen als Subspezies der *M. versicolor* auf.

Als nota characteristica des ganzen Formenkreises muss in erster Linie das Aussehen der Teilfrüchte angeführt werden mit dem scharf abgesetzten Randsaum und der schmalen, in der Breite ausgezogenen Ansatzfläche (Fig. 1 *a*). Auch die zuwachsende und aus dem Kelch hinausragende Kronenröhre ist ein gutes Kennzeichen. Habituelle Eigentümlichkeiten des Fruchtstandes werden unten unter *M. versicolor* erwähnt.

Keiner von diesen 5 Typen ist neu, die meisten sind schon von A. Jordan in einwandsfreier Weise unterschieden worden. Meine Darstellung beabsichtigt nur, durch Verwendung einiger besonders aus den Fruchtkelchen geholten Kennzeichen die Unterscheidungsmerkmale der genannten Typen so deutlich wie möglich hervorzuheben. In diesem Zusammenhange ist es angebracht, Alexis Jordan's zu gedenken, dieses genialen Forschers und Arztes in Lyon (1814—1887), der in seiner Forschung vor seiner Zeit war und daher allzu wenig verstanden wurde.

Geographische Verbreitung. — Die Gesamtart *M. versicolor* ist eine vorwiegend westliche Pflanze. Im Westen, z. B. in

Fig. 1. Nüsschen von *a Myosotis versicolor, b M. stricta, c M. collina.* $^{20}/_{1}$. Thérèse Ekblom del.

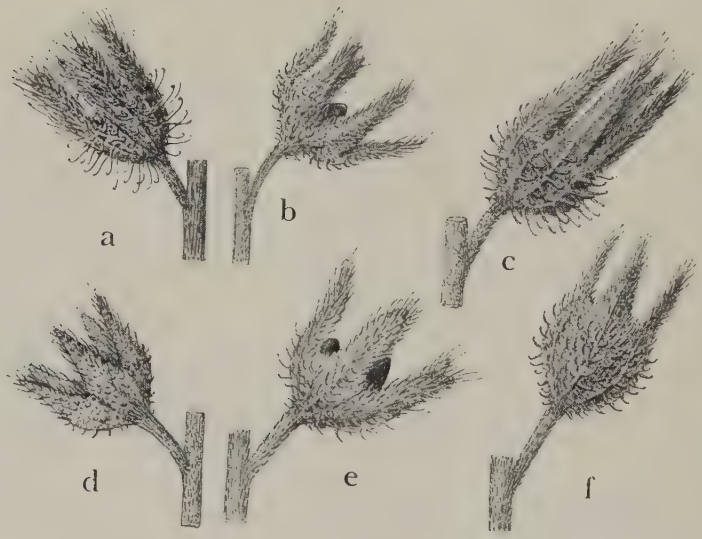

Fig. 2. Fruchtkelche von *a Myosotis lutea:* Castille, Madrid à El Pardo, T. Sennen 3118, *b M. Balbisiana:* Frankreich, Gard, Aumessas, Grenier 1859, *c M. versicolor* ssp. *longicalyx:* Elsass, Haguenau, C. Billot 1846, n:o 158, *d M. versicolor* ssp. *fallacina:* Lyon, leg. Jordan, *e* ssp. *fallacina:* ex Anglia 1815 (Herb. Swartz), *f M. versicolor* ssp. *dubia:* Frankreich, Calvados, Deauville, Herb. E. Cosson 1843. $^{8}/_{1}$. — Thérèse Ekblom del.

Frankreich und Grossbritannien, kommt sie am häufigsten vor, gegen Osten wird sie immer spärlicher. Von den 5 Typen kommen in Frankreich 4 vor, in Grossbritannien 3, in Schweden 2, eine *(M. lutea)* ist auf die Pyrenäische Halbinsel beschränkt. Aus dem östlichen Teil des Verbreitungsgebietes (Österreich, Ungarn, Bos-

nien) habe ich nur einen Typus, *M. versicolor* ssp. *longicalyx*, gesehen. Im Süden erreicht *M. versicolor* angeblich die Atlasländer, aus Madeira habe ich ein Exemplar der Ssp. *dubia* gesehen, für Italien wird sie bis Sizilien angegeben (12), im Osten soll sie nach dem Nordbalkan, der Ukraine, der Türkei und dem Kaukasus ausstrahlen (11). Inwieweit sie ausserhalb des Gebietes ihrer Hauptverbreitung adventiv oder ursprünglich auftritt, ist unbekannt. Sowohl in Nord- als Südamerika ist sie adventiv gefunden. Dass sie nach Hegi (11) »noch entschiedener als *M. micrantha*» (= *M. stricta* Link) Kalkboden meiden sollte, stimmt nicht zu meinen Erfahrungen von diesen beiden Arten.

Samenverbreitung. 1) Ferntransport durch Tiere. — Unterhalb des Fruchtkelches bricht der Stiel an einer helleren Trennungsstelle leicht ab, und die Fruchtkelche mit den einliegenden Nüsschen haften durch die Haken des Kelchtubus an Vorbeigehenden. 2) Aussähen auf dem Standort. — Die aus dem Blütenboden losgelösten Nüsschen fallen aus dem Kelch heraus, welcher Prozess durch den Seitendruck der sich beim Welken zusammendrückenden Fruchtkelchzipfel begünstigt wird. Dies kann natürlich auch während des Tiertransportes vor sich gehen. Endozoische Samenverbreitung, die von Hegi (11) in Frage gestellt wird, ist ausgeschlossen, da die Fruchtwand äusserst zerbrechlich ist. Beim Aufbewahren müssen sogar die Nüsschen der *Myosotis*-Arten vor Druck geschützt werden, da sie in einem gewöhnlichen Papierkonvolute leicht zerbrechen.

Myosotis lutea (Cavanilles p. p.) Hoffmannsegg & Link. (Fig. 2 *a*).

Dieser auf die pyrenäische Halbinsel beschränkte Typus scheint mir von der nächstverwandten *Myosotis versicolor* (Pers.) J. E. Sm. genügend verschieden, um als Art aufrechterhalten zu werden.

Der Blütenstand beginnt nicht weit von der Basis des Stengels, an kleinen Individuen schon an den ersten Blättern. Der Blütenstand ist daher im unteren Teil, an den Seitenzweigen oft hoch hinauf beblättert. In dieser Hinsicht erinnert *M. lutea* an *M. stricta* Link (1).

Die Blütenkrone ist verhältnismässig gross: in Milchsäure erweicht, zeigt der Tubus eine Länge von 2—2,5 mm und der Kronensaum eine Breite von 2,3—2,6 mm. Farbe gesättigt gelb. Der Tubus ragt, völlig ausgewachsen, aus dem Kelch hinaus.

Der Fruchtkelch ist klein, völlig ausgewachsen höchstens 3—3,5

mm lang, bis zur Mitte eingeschnitten. Der Stiel ist kürzer als der Kelch, etwa 2 mm lang. Die Kelchzipfel sind schmal, spitz, an den Enden von langen, geraden, weissen Borsthaaren überragt. Der Bauchteil des Kelches trägt lange, wagerecht abstehende Hakenhaare von etwa 0,5 mm Länge.

Ich habe nur kleinere Exemplare gesehen, 2—20 cm hoch. Der Stengel ist angedrückt behaart. Die reiche Verzweigung aus dem unteren Teil des Stengels hat *M. lutea* mit anderen einjährigen *Myosotis*-Arten gemeinsam. Die Frucht weicht von derjenigen von *M. versicolor* nicht ab.

Unterscheidungsmerkmale. — Der im unteren Teil beblätterte Blütenstand, der in der Regel unweit der Stengelbasis ansetzt, die kleinen, kräftig bewaffneten Fruchtkelche mit verhältnismässig kurzen Kelchzipfeln, und die verhältnismässig grosse, gesättigt gelbe, nie farbenwechselnde Blütenkrone.

Diese Kennzeichen scheinen mir zu genügen, um diesen iberischen Typus von *M. versicolor* getrennt zu halten. Im Vergleich mit *M. lutea* hat *M. versicolor* nicht (oder selten an den Seitenzweigen unbedeutend) beblätterten Blütenstand (in der Regel eine unbeblätterte Stengelpartie zwischen der Blattregion und dem Blütenstand), grössere Fruchtkelche mit längeren Kelchzipfeln (die langen Kelchzipfel sind für *M. versicolor* sehr charakteristisch), kürzere und gröbere Hakenhaare; die Krone ist in der Regel kleiner als bei *M. lutea* und nicht so gesättigt gelb, farbenwechselnd aus blassgelb (oder sogar weiss) nach blau.

Von dieser in den Herbarien spärlich vorkommenden Art standen mir zur Verfügung zwei schöne und reichhaltige Exemplare aus der Umgebung von Madrid (»loc. class.»), nämlich F. Sennen, Plantes d'Espagne 2912 und 3118, ferner Flora lusitanica exs. 917 aus Villar Formoso, Valle Fundo, M. Ferreira 1890 (alles aus Herb. Degen). Ein Kollekt von Joh. Lange: Cerro Colgamoros supra Escorial (Herb. Upsal. et Holm.) weicht durch kürzere Hakenhaare des Kelches ab.

Nomenklatur. — Als erster Name dieser Art gilt *Anchusa lutea* Canvanilles 1791 (2), die sowohl *Lithospermum apulum* (L.) Vahl als *M. lutea* zu umfassen scheint. Die Arbeit Cavanilles' steht mir nicht zur Verfügung, aber nach Schinz & Thellung (3) beziehen sich *Anchusa lutea* des Cavanillesschen Herbars und die von ihm angeführten Synonyme auf *Lithospermum apulum*, wogegen die Abbildung *M. lutea* zeigen soll. Als Auktor der *M. lutea* gilt

Persoon 1805 (4), aber sein Ausdruck »radix rubescens» weist deutlich auf den roten Farbstoff der *Lithospermum*-Wurzel. Seine Beschreibung dürfte wohl auf Cavanilles' Beschreibung fussen. Cavanilles ist also pro minima parte (nur wegen der Abbildung), Persoon aber gar nicht als Auktor der Art anzusehen.

Die erste, sich nur auf *Myosotis lutea* beziehende, Beschreibung liefern Hoffmannsegg & Link 1809 in ihrem Prachtwerke über die portugiesische Flora (5), wo sie Cavanilles exclusis synonymis zitieren. Die Art dürfte also am besten als *Myosotis lutea* (Cavanilles p. p.) Hoffmannsegg & Link zu bezeichnen sein.

Willkomm & Lange 1840 (6) führen in ihrem Prodromus *M. lutea* auf mit der Bemerkung: »Ceterum specici praecedenti (*M. versicolor*) simillima, a quo vix specifice differt». Die Beschreibung ist allgemein und unbestimmt gehalten ohne verwendbare Unterscheidungsmerkmale, mit Ausnahme der Blütenfarbe. Es ist dies ein allbekannter Übelstand vieler älteren floristischen Arbeiten, der zur Vorsicht mahnt. Wenn Schinz & Thellung (3), ohne die Pflanze selbst zu untersuchen, nur auf Grund eines Vergleiches der Beschreibung der *M. lutea* bei Willkomm & Lange mit der schweizerischen *M. versicolor* aus Prioritätsgründen den seit mehr als einem Jahrhundert benutzten, sehr zutreffenden Namen *M. versicolor* in *M. lutea* abändern, muss dies a priori als allzu schwach begründet angesehen werden. Letzteres wird ja auch durch eine vergleichende Untersuchung der betreffenden Pflanzen bestätigt.

Myosotis Balbisiana Jordan (Fig. 2 *b*).

Diese Jordansche Art ist eine zweite, permanent gelbblütige Art aus dem Kreise der *M. versicolor*. Sie scheint ausschliesslich in Frankreich verbreitet zu sein. Von *M. lutea*, sowie von *M. versicolor*, lässt sie sich sehr leicht unterscheiden.

Der Blütenstand ist im Gegensatz zu *M. lutea* kurz und auf den obersten Teil des Stengels und der Seitenzweige beschränkt. In vorgeschrittenem Stadium, wo die unteren Blüten schon völlig reife Früchte tragen, zeigt der Blütenstand eine Länge von nur 2—6 cm. Ein blattloser Stengelstrich, bis 3mal länger als der Blütenstand, erstreckt sich zwischen der Blatt- und der Blütenregion. Dieser den Blütenstand erhebende Stengelteil ist sehr grazil, was der ganzen Pflanze ein zartes und weiches Aussehen erteilt.

Die Blütenkrone ist kleiner als bei *M. lutea* und von einer lebhaft gelben Farbe. Eine der grössten Korollen zeigte, in Milchsäure

erweicht, einen nur 1,3 mm weiten Kronensaum und einen 1,3 mm langen Tubus. Am Ende des Blühens ragt der Tubus aus dem Kelch hinaus.

Der Fruchtkelch ist sehr klein, nur 2,5—3 mm lang, auf einem kurzen, 1,5 mm langen Stiel. Sehr charakteristisch für die Art ist die tiefe Einschnittung des Kelches, der bis unweit der Kelchbasis geteilt ist. Trotzdem zeigen die etwa 2 mm langen Kelchzipfel nicht das ausgezogene Aussehen, das für *M. versicolor* so charakteristisch ist. Die Hakenbewaffnung ist schwach und spärlich.

Die Pflanze ist ziemlich hochgewachsen mit verlängerten Stengelgliedern (grosse Interstitien besonders zwischen den oberen Blättern). Die Stengelhöhe schwankt an den von mir gesehenen Exemplaren zwischen 8 bis 23 cm. Der Stengel trägt eine Mischung von angedrückten und ausgesperrten Haaren.

Die auch hier sphärischen Pollenkörner zeigten sich kleiner als bei *M. lutea* und *versicolor*, 15—16,5 μ im Durchmesser.

Früchte wie bei *M. versicolor*, aber mehr hellbraun.

Unterscheidungsmerkmale. — Infloreszenz kurz, von einem langen, blattlosen, grazilen Stengelteil erhoben. Korolle klein, dauernd gelb. Fruchtkelch klein, tief bis unweit der Kelchbasis eingeschnitten, mit kleinen und spärlichen Hakenhaaren.

Demgegenüber hat *M. lutea* grössere Korolle, einen unweit der Stengelbasis ansetzenden, beblätterten Blütenstand und lange Hakenhaare des Fruchtkelches, *M. versicolor* farbenwechselnde Korolle und grössere Fruchtkelche mit ausgezogenen Kelchzipfeln, sowie eine längere, nicht oder selten unbedeutend beblätterte Infloreszenz.

Myosotis Balbisiana scheint ein sehr einheitlicher Typus zu sein. Keine Übergänge oder Variationen sind beobachtet worden. Folgende ausschliesslich französische Exemplare standen mir zur Verfügung:

Rhône: Lyon à S:t Bonnat, A. Jordan 1864. Authentisches Exemplar aus dem Herb. Degen; Vaugneray prope Lyon, Jordan, Herb. Upsal. (sub nom. *M. lutea,* vor der Ausscheidung der *M. Balbisiana* gesammelt); Vaugneray, pelouses granitiques, H. Perret 1900, Herb. Degen; Puy-de-Dome: Villars près Clermont-Ferrand, Heribaud 1878 (Herb. Holm.); Lyon, Grenier 1850, 1857, Herb. Holm., Upsal.

Tarn: dans les moissons des champs du terrain granitique des environs d'Anglès, H. de Larambergue & Fabre 1859 (F. Schultz, Herb. norm. 529).

Aveyron: leg. Saltel 1881, Herb. Degen.

Gard: Aumessas (?), Grenier 1859, Herb. Holm.

Gironde: terrain sablonneux à Hourtin, J. Foucaud 1885, Herb. Degen.

Verbreitung. — *M. Balbisiana* Jord. scheint eine französische Endeme zu sein (7). Da sie die einzige permanent gelbblütige *Myosotis*-Art Frankreichs ist, ist ihre Identifizierung im Felde leicht. Rouy (6), der sie als »Race» unter *M. versicolor* aufführt, gibt folgende Verbreitung aus dem mittleren und südlichen Frankreich an: »Lieux sablonneux, bords des bois: Rhône, Loire, Bourgogne, Gironde, Calvados, Bretagne, plateau central: du Gard à l'Allier, Hérault, Tarn, Tarn-et-Garonne.»

Nomenklatur. — Nach der Aufstellung dieser ausgezeichneten Art von A. Jordan 1852 (8) hat ihre Benennung keine andere Veränderung erfahren, als dass mehrere Verfasser (9) sie als Varietät oder Subspezies unter *M. versicolor* aufgeführt haben. Vor Jordan hatte sie G. B. Balbis 1827 (10) in seiner Flore Lyonnaise erwähnt und mit *M. lutea* identifiziert, weshalb Jordan sie nach diesem Verfasser benannte. Als locus classicus ist Lyon anzusehen.

Myosotis versicolor (Pers.) J. E. Smith (Fig. 1 *a*).

Eine wertvolle nota characteristica ist diejenige, auf welche der Name dieser Pflanze hindeutet, nämlich das Farbenwechseln der Blütenkrone: von blassgelb, hellgelb oder weiss (letzteres bei der subsp. *dubia* und selten bei der subsp. *longicalyx*) über rosa nach blau und blauviolett. Die Kronenröhre ist von Anfang an (schon in der Knospe) violett.

Auch ohne die Blütenkrone braucht man niemals in Verlegenheit wegen genügender Kennzeichen dieser Art zu sein. Es scheint mir jedoch nicht gerade leicht zu präzisieren, warum diese Art beim ersten Anblick so leicht zu erkennen ist. Es sind da die verhältnismässig grossen (langen) Fruchtkelche mit wohl entwickeltem Bauchteil und lang ausgezogenen Kelchzipfeln an sehr regelmässig stehenden, kurzen (wie etwa der halbe Kelch, jedoch nicht so kurz wie bei *M. stricta*), starren, schräg nach oben abstehenden Stielen. Es sind noch die mässig langen Hakenhaare des Fruchtkelchbauches, die nicht so lang sind wie bei *M. collina* und nicht »heruntergekämmt» wie bei *M. stricta*. Zu bemerken ist jedoch, dass die Fruchtkelche in ihrer Form und Bewaffnung nicht einheitlich sind, da eben die Fruchtkelche die besten Unterscheidungsmerkmale der drei Unterarten liefern, in die *M. versicolor* sich meiner Meinung nach zerteilen lässt.

Einen zuverlässigen Charakter liefert die Frucht, wenn es gilt, den Verwandtschaftskreis der *M. versicolor* zu charakterisieren, d. h.

die drei Arten *versicolor, lutea* und *Balbisiana*, die in der Form ihrer Früchte übereinstimmen. Die Teilfrüchte der *M. versicolor* sind grösser als bei *M. stricta* und *collina*, 1,1—1,3 mm lang und 0,7—0,8 mm breit, eiförmig bis oval, von schwarzbrauner Farbe, mit einem deutlich abgesetzten Randsaum und schmaler, in die Breite ausgezogener, unsymmetrischer Ansatzfläche.

Sehr charakteristisch ist an den jüngeren Blütenständen der *M. versicolor* die kräftige, elegant eingerollte Gipfelspirale dichtstehender Blüten. Das kräftige Aussehen der Spirale wird vor allem dadurch bewirkt, dass die jungen, dicht angehäuften Fruchtkelche schon in diesem frühen Stadium weit ausgewachsen sind.

Die Stengelblätter sind länglich bis schmal lanzettlich, langgestreckt und ziemlich spitz.

Betreffs der Beblätterung des Blütenstandes, die für gewisse Arten, wie *M. stricta, pusilla* und *lutea* als guter Charakter gilt, muss hier hervorgehoben werden, dass an wohlentwickelten Exemplaren der *M. versicolor* ein kahler (d. h. nicht blatt- oder blütentragender) Stengelstreifen die Blatt- und Blütenregion trennt, der dazu dient, den Blütenstand in die Höhe zu erheben. Nur an kleinen Seitenzweigen oder an Zwergexemplaren, wo nur wenige Blüten sich entwickeln, findet man bisweilen die unterste Blüte in der Region der Laubblätter.

Subsp. *α longicalyx* mihi (Fig. 2 *c*).

Caulis elongatus, gracilis. Calyx fructiferus viridis, elongatus, laciniis angustis, sublinearibus, apice acutatis, elongatis, tubo longioribus, pilis uncinatis longiusculis praesertim secus nervos valde prominentes armatus. Corolla majuscula, limbo circ. 3 mm in diam., ex luteoalbo vel albo coerulescens.

Der Stengel ist dünn und relativ hochgewachsen, 20—35 cm lang, angedrückt behaart oder im unteren Teil mit einer Mischung von angedrückten und abstehenden Haaren bekleidet. Der Fruchtstand ist ausgezogen, 10—25 cm lang, mit ziemlich entfernt stehenden Fruchtkelchen.

Die Korolle ist anfangs schwach gelb oder weiss, dann blau bis violett, relativ gross, mit etwa 3 mm breitem Saum und etwa 2 mm langem Tubus, der am Ende des Blühens aus dem Kelch hinausragt.

Fruchtkelch rein grün oder nur schwach blauschwarz gefärbt, langgestreckt, 4—5 mm lang mit etwa 2 mm langem Kelchtubus. Kelchzipfel ausgezogen, 2,5—3 mm lang, schmal, fast

länglich, am Ende zugespitzt. Die Nerven treten kräftig hervor, die Hakenhaare sind kräftig entwickelt und besonders an den Nerven zahlreich.

Die sphärischen Pollenkörner zählen im Durchmesser 18—19,5 μ.

Unterscheidungsmerkmale. — Der ausgezogene Stengel und Blütenstand; die relativ grosse, anfangs nur schwach gelbe oder weisse Korolle; der verlängerte, grüne Fruchtkelch mit seinen stark vorspringenden Nerven; die langen, schmalen, fast länglichen Kelchzipfel, die länger sind, als der kräftig hakenbewaffnete Kelchbauch.

Nomenklatur. — *M. versicolor* wird zum erstenmal 1805 von C. H. Persoon (4) als *M. arvensis* γ? *versicolor* beschrieben. J. E. Smith (12) führt sie 1814 (12) als selbständige Art, *M. versicolor*, auf, und sie ist daher als *M. versicolor* (Pers.) J. E. Smith zu bezeichnen. Smith zitiert jedoch nicht Persoon für den Namen. Siehe weiteres unter ssp. *fallacina*!

Verbreitung. — *M. versicolor* ssp. α *longicalyx* mihi ist über das ganze Verbreitungsgebiet der Art vorhanden. Im Osten des Gebietes scheint sie der einzige Repräsentant der Art zu sein. Die Nordgrenze ist Schweden, Hasseludden bei Stockholm. Folgende Fundorte habe ich verzeichnet.

Schweden (alles aus Herb. Stockh.).

Skåne: Ystad mot Nybro vid vägen, Fr. E. Ahlfvengren 1902; Helsingborg, P. W. Strandmark 1890; Arlöfs strandängar, Rudolf Larsson 1890 (zusammen mit Subsp. *fallacina* auf demselben Bogen); Refvinge, i högt gräs, F. R. Aulin 1908; Ringsjön, G. W. Montelin 1904. Halland: Halmstad, Väster, Fr. E. Ahlfvengren 1908. Småland: Wäxiö, C. Pleijel 1920; Kalmar s:n, Skälby, G. L. Björkman 1898. Västergötland: Björkås vid Halleberg, A. S. Trolander 1888; Skallsjö s:n, Tollered, Aug. Bagge 1890; Skallsjö s:n, Bäckatorpet, Aug. Bagge 1894; Kållandsö, Ullereds bro, Olof Östergren 1892; Mariestad, Torstorp, Bror Nilsson 1887. Dalsland: Ödeborgs s:n, åker söder om kyrkan, Gunnar Johansson 1925. Bohuslän: Ljungs s:n vid Berg, Carl Sandberg 1927. Nerike: Askersunds stadsegor, Oskar Wijkström 1882. Östergötland: Tåby s:n, Stensvad, P. A. Issén, 1908. Upland: Wermdön, Hasseludden, I. Kolthoff 1923.

Norwegen.

Fredrikshald, Holtermann 1882 (Herb. Stockh.).

Dänemark.

Sorö, J. Lange 1846 (Herb. Stockh.).

Island.

J. Vahl (zusammen mit ssp. *fallacina*; Herb. Upsal.); Reikjavik, C. Grönlund 1868 (Herb. Upsal.).

Schottland.

Inverness-shire, Tomatin, G. Samuelsson (mit *fallacina*; Herb. Upsal.).

Frankreich.

Eure, champs de Montaure, Abbé Toussaint (sub nom. *M. dubia* Arrondeau; Herb. Degen); Paris, Bois de Boulogne (Herb. Stockh.); Rhône, Lyon, Herb. Jordan (Herb. Upsal.); Rhône, Vaugneray, pelouses granitiques, H. Perret 1900 (sub nom. *M. Balbisiana*; Herb. Degen).

Schweiz.

Aargau, Heilernplatz bei Sofingen, Hans Siegfried 1873 (Herb. Upsal.); Genève: bord des champs au-dessus du bois de la Bâtie près Genève, Th. Brown 1871 (Herb. Upsal.).

Deutschland.

Elsass, champs sablonneux ou peu humides à Haguenau, C. Billot 1846 (Fl. Gall. & Germ. exs. 158, Herb. Stockh.); Baden, Carlsruhe, A. Br. (Herb. Upsal.); Bayern, Donaumoor bei Karlshuld, W. Gugler 1905 (Herb. Degen); Weimar, in monte Ettersberg, J. Bornmüller 1896 (Herb. Stockh.); Sachsen, Plauenscher Grund bei Dresden, G. Reichenbach (Fl. germ. exs. 1174, Herb. Stockh.); Thüringen, Stockhäuser Forst bei Sondershausen auf Buntsandstein, F. Heinmann 1884 (Herb. Upsal.); Sachsen, Leipzig, W. Hofmust (Herb. Upsal.); Schlesien, Carlowitz bei Breslau (Herb. Stockh.); Breslau bei Wilhelmshafen, Hellmann 1891 (Herb. Stockh.).

Böhmen.

Plon i. B., Heideboden, J. Jahn 1912 (Herb. Stockh., Petrák 1517); Weidenau, Felder am Sandberg, I. Hruby 1910, Petrák 486 (Herb. Stockh.).

Österreich.

Austria superior, inter segetes in colle Rothbuchberg prope Ried, leg. Ritzberger (Pl. exs. austro-hung. 2937, Herb. Stockh., Herb. Degen); Wien, Hameau bei Neuwaldegg, N. P. Reuss 1869 (Herb. Degen); Bergwiesen im Lainzer Tiergarten bei Wien, K. Ronniger 1919 (Herb. Stockh.)

Ungarn.

Comit. Posniensis, in agris incultis prope Lozorno, c. 190 m, Jos. Scheffer 1919 (Herb. Degen); comit. Arad, in pascuis montanis ad Aranyág, Simonkai 1888 (Herb. Degen); com. Zala, Misefa, F. Kovats 1928 (Herb. Degen).

Transsylvania.

Distr. Treiscaun Rétyi Nyir prope pagum Réty, F. Kovács 1911 (Herb. Stockh.).

Spanien.

Catalogne, S. Climent, Vilarnadal et Agullana, F. Sennen 1908 No. 576 (Herb. Degen); Cerdagne, Estevar, Llivia, Targasonne, prairies humides des couteaux, 1250—1600 m. F. Sennen 1926, No. 5809 (Herb. Degen); Madrid, Casa de Campo, lieux frais, Hno. Jerónimo 1920, Sennen 3991 (Herb. Degen).

Subsp. *β* ***fallacina*** (Jordan) mihi (Fig. 2 *d, e*).

Humilis, saepe robustior. Calyx fructiferus atrocyaneus, brevior, circ. 4 mm longus, laciniis latiusculis, e basi latiori versus apicem sensim attenuatis, breviusculis, 2 mm longis, e longitudine tubi, nervis non prominulis pilis uncinatis minutis, sparsis, parum distantibus. Corolla majuscula, limbo circ. 3 mm in diam., ex luteo coerulescens.

Der Stengel ist niedriger als bei *α*, 6—16, selten bis 30 cm lang, und die ganze Pflanze durchweg mehr robust. Die Behaarung des Stengels ist angedrückt oder im unteren Teil eine Mischung von angedrückten und abstehenden Haaren. Der Fruchtstand ist mehr gedrungen, selten über 10 cm lang, oft kürzer, mit dichter stehenden Fruchtkelchen.

Die Korolle scheint im Anfang des Blühens eine stärker gelbe Farbe als bei *α* zu besitzen und wechselt dann in der Farbe wie diese. Die Grösse der Korolle ist dieselbe wie bei *longicalyx* und der Saum 2,5—3 mm breit.

Der Fruchtkelch ist kürzer als bei *longicalyx,* etwa 4 mm lang und hat eine trübe, schwarzblaue Farbe. Die Kelchzipfel sind kürzer und breiter als bei *longicalyx,* etwa 2 mm lang und von der Länge des Kelchtubus, von der Basis gegen die Spitze allmählich verjüngt. Die Nerven treten nicht hervor, und in der Bekleidung des Kelches dominieren die kürzeren oder längeren angedrückten Haare, während die Hakenbewaffnung schwach ist mit kleinen und kurzen, wenig zahlreichen und wenig abstehenden Hakenhaaren.

Pollenkörner sphärisch, 18—19,5 *μ* im Durchmesser.

Unterscheidungsmerkmale. — Wuchs mehr gedrungen; Korolle anfangs mehr deutlich gelb; Fruchtkelch kürzer, blauschwarz, ohne vorspringende Nerven; Kelchzipfel breiter und kürzer, gegen die Spitze allmählich verjüngt, von der Länge des schwach hakenbewaffneten Kelchbauches.

Demgegenüber zu beachten bei *α longicalyx*: höherer Stengel, lockerer Blütenstand, schwach gelbe oder weisse Korolle, grüner, langer Fruchtkelch mit vorspringenden Nerven, starker Hakenbewaffnung und langen, schmalen Kelchzipfeln, die länger sind als der Kelchtubus.

Die Angabe, dass die Kronenröhre der *β fallacina* sich nicht am Ende des Blühens verlängern sollte (8, 9, 11), finde ich nicht zutreffend. Selbst an einem authentischen Exemplar Jordans (Herb. Degen) sieht man die Korolle in ihrem späteren blauen Stadium mit dem verlängerten Tubus aus dem Kelche hinausragen. Nach Crépin (9) ist die Tubuslänge der Korolle ein schwankender Charakter. Nach Hegis Flora (11) soll die Streckung der Kronenröhre nur dann eintreffen, wenn die Bestäubung durch Insekten ausbleibt, um dadurch Selbstbestäubung zu bewirken, welche Angabe mir näherer Prüfung zu bedürfen scheint. Vorläufig glaube ich nicht daran.

Nomenklatur. — Dieser Typus wurde von A. Jordan als besondere Art in Boreaus Flore du Centre 1857 beschrieben (13). Es wäre nicht leicht gewesen, nur nach der Beschreibung diesen Typus zu identifizieren, da der oben erwähnte Charakter der Tubuslänge, den man häufig auch in späteren Floren als einziges Unterscheidungsmerkmal wiederfindet, wenig zuverlässig ist. Es traf sich aber so glücklich, dass ein reichhaltiges, authentisches Exemplar der *M. fallacina* Jord. mit von Jordan geschriebener Etikette sich in der mir zur Verfügung gestellten, überaus lehrreichen *Myosotis*-Sammlung A. von Degens vorfand. Es zeigte sich, dass dieses Exemplar einen in Frankreich, England und Schweden etc. verbreiteten, durch die Fruchtkelche leicht kenntlichen Typus, den obigen *β fallacina,* repräsentierte. Jordan betrachtet seine *M. fallacina* als nahe verwandt mit *M. Balbisiana*, denn er sagt nach der Beschreibung: »souvent mêlé au *Balbisiana* dont il est très voisin, mais constammant distinct.» In der Tat ist auch *fallacina* inbezug auf die Fruchtkelche der *M. Balbisiana* wenigstens habituell sehr ähnlich. Ein bei Lyon gesammeltes, im Herb. Upsal. vorhandenes Exemplar aus dem Herb. Jordan, mit dem Namen *M. versicolor*, zeigt meine ssp. *α longicalyx*.

Die Figur der *M. versicolor* J. E. Smith (1814) in English Botany, tab. 480 fig. 1, scheint sich auf ssp. *β fallacina* zu beziehen. Ein Herbarexemplar mit Wahlenbergs Handschrift: »M. versicolor. Ex Anglia data a Cel. Swartz 1815» zeigt auch die *β fallacina*

(mit Einmischung der *M. stricta*). Die Reste des Exemplars, das so unmittelbar nach der Aufstellung der *M. versicolor* aus England an Swartz gesandt wurde, liegt im Herb. Holm. mit der Aufschrift: »Myosotis versicolor. Ubique. Ex Anglia. Herb. Swartzii.» Jordan betrachtet indessen meine oben beschriebene ssp. *α longicalyx* als Typus der *M. versicolor*, wozu er natürlich berechtigt ist, und ich bin ihm darin gefolgt.

Verbreitung. — *M. versicolor* ssp. *fallacina* gehört dem westlichen und Hauptteil des Verbreitungsgebietes der *M. versicolor* an. In Schweden scheint sie beinahe häufiger als die ssp. *longicalyx* zu sein. Die Nordgrenze verläuft in Schweden: Uppland, kleine Insel in der Föhrde Gälnan des Kirchspiels Ljusterö in den Stockholmer Schären, zugleich die absolute Nordgrenze der *M. versicolor* in der ganzen Welt.

Folgende Fundorte sind von mir verzeichnet worden.

Schweden (alles aus Herb. Stockh.).

Skåne: Bronstaholm, J. Svensson 1859; Limhamn, A. Tullberg 1867. Blekinge: Knösö, K. F. Thedenius 1876. Halland: Släps s:n, Kullen, J. E. Palmér 1905. Småland: Västervik, Långhagen, Herb. C. M. Nyman, 1869; Västervik, Grantorpet, E. Wahlén 1861. Västergötland: Saltet nedanför Trollhättan, Karl Rahne 1909; Skara, K. B. J. Forssell 1874; Sunnersberg, Frösslunda, J. A. O. Skårman 1926; Otterstad, Nybygget, fuktig landsvägskant, J. A. O. Skårman 1923. Göteborg: Ramberget, H. Thedenius 1869. Bohuslän: Uddevalla vid Annegretebog, T. O. B. N. Krok 1855; Mjörn, Hj. G. Konow 1883; ad Wessby Boh. boreal., C. J. Nordquist 1854. Östergötland: på en berghäll nära Ryd utanför Linköping; Jonsbergs säteri, J. A. Lewin 1891; Nyköping, Oxelösund, Conrad Indebetou 1869; Dalarö på södra stranden, Rosell 1861; Trosa, Thjelvar Molér 1894. Södermanland: Nacka s:n, Neglinge, Sten Velander 1894. Uppland: Ljusterö s:n, holme i Gälnan, Sten Selander 1917. Öland: Vickleby, Lilla Vickleby skog, Vilhelm Ekström 1918; Borgholm, bland slånbuskar på betesmark söder om staden, K. F. Dusén 1898. Gotland: Sundre, Djufves, strandängen, K. Johansson 1888; Sanda prästgård, sandfält, E. Th. Fries 1913.

Island.

J. Vahl (zusammen mit ssp. *longicalyx*, Herb. Upsal.).

Schottland.

Inverness-shire, Tomatin, G. Samuelsson 1909 (mit ssp. *longicalyx*, Herb. Upsal.).

England.

Bath, Charles C. Babington (mit ssp. *dubia*, Herb. Upsal.).

Frankreich.

Eure, Evreux, P. Fournier 1908 (sub nom. *M. Balbisiana*, mit Übergangsform *fallacina-longicalyx*, Herb. Stockh.); Orne, rochers de Mont Milvent, D. D. 1846, Herb. E. Cosson (mit ssp. *dubia*; Herb. Stockh.); Morbihan, Josselin, O. du Noday 1885 (Herb. Upsal.); Rhône, Lyon à Chasselay, A. Jordan 1869 (Herb. Degen).

Portugal.

Cabeceiras de Basta, Henriques 1881 (Herb. Stockh.).

Deutschland.

»Dresd. fl.», Reichenbach jun. misit 1845 (Herb. Stockh.); »Fl. Gott.» (= Göttingen; Herb. Stockh.).

Zwischenformen.

Zwischen den beiden oben beschriebenen Typen *α longicalyx* und *β fallacina*, die in ihrer typischen Ausbildung so gut getrennt erscheinen, dass sie beim ersten Anblick leicht zu erkennen sind, gibt es Übergänge, die nicht gerade selten sind. Das reichhaltige Material aus Schweden, das mir zur Verfügung steht, zeigt dies zur Genüge. Es gibt Formen, die hinsichtlich der Länge des Kelches die Mitte zwischen den beiden Typen halten, Formen mit zwar breiten und kurzen, aber gleichzeitig kräftig hakenbewaffneten Kelchzipfeln mit vorspringenden Nerven usw. Besonders häufig ist eine Form, die von der typischen *fallacina* nur dadurch abweicht, dass die Kelchzipfel länger sind als bei dieser (14). Es gibt aber auch eine Form, die lange und breite Kelchzipfel und starke Hakenbewaffnung des Kelchtubus hat, also zwei *longicalyx*-Charaktere.

Wie diese »Zwischenformen» zu deuten sind, lässt sich ja nicht auf vergleichend morphologischem Wege entscheiden. Vielleicht sind sie erblich fixierte Typen, vielleicht auch Hybriden und Hybridspaltungen, denn tatsächlich wachsen die beiden Typen *longicalyx* und *fallacina* bisweilen zusammen, was ihr Vorkommen auf einem und demselben Herbarbogen deutlich zeigt. Allerdings ist man berechtigt, die beiden Typen *longicalyx* und *fallacina* zu unterscheiden, denn sie sind 1) innerhalb der Art häufig, 2) weit verbreitet, 3) sie haben einen eigenen Habitus. Und was ist der Habitus? Nach meiner Auffassung ist der Habitus die Zusammenfassung einer Reihe fixer Charaktere, die den artsystematischen Typus konstituieren und ihm ein eigenes, leicht erkennbares Aussehen

geben. Diejenigen Modifikationen dieses Habitus, die auf Modifikationen in Klima und Boden beruhen, sind im allgemeinen leicht zu durchschauen. Die in Rede stehenden Formen sind also keine zufälligen Kombinationen, sondern uralte fixierte Typen, deren Charaktere sich auch in den Zwischenformen erkennen lassen. Jordan hat vielleicht recht, wenn er sie als Arten betrachtet (15). Wegen der Zwischenformen führe ich sie aus praktischen Gründen als Subspezies auf (aber nicht als Varietäten, weil sie eine Mehrzahl Charaktere besitzen und somit auch einen eigenen Habitus).

Subsp. *γ* ***dubia*** (Arrondeau) mihi (Fig. 2 *f*).

Caulis elatus, squarrose hispidus. Tubus calycis auctus, laciniis longior vel iis demum aequilongus, secus nervos valde prominentes pilis uncinatis, robustis, breviusculis, crebris armatus, laciniis angustis, versus apicem sensim attenuatis, tubo brevioribus vel demum eo subaequilongis. Corolla minuta, limbo 1—2 mm in diam., ex albo pallide coerulescens.

Der Stengel ist auffallend hochgewachsen, 15—35 cm, vielblättrig und bis an die Nähe des Blütenstandes beblättert, mit ausschliesslich winkelrecht abstehenden, langen rauhen Haaren bekleidet. Erst in der Nähe des Blütenstandes mischen sich anliegende Haare ein.

Der Fruchtstand ist kurz, 5—12 cm, mit ziemlich dichtstehenden, wegen des vergrösserten Kelchtubus gross aussehenden Fruchtkelchen an oft auswärtsgebogenen Stielen.

Die Korolle ist auffallend klein mit einem halboffenen, nur 1—2 mm breiten Saum und 1,3—1,8 mm langem Tubus. An den von mir kultivierten Exemplaren erreichte der Tubus nur die Länge des Blütenkelches oder kaum mehr als diese. Die Blütenfarbe ist anfangs weiss, dann blassblau mit oben rotviolettem Tubus.

Den Kelch fand ich im Blütenstadium 2,5 mm lang mit 1 mm langen Zipfeln. Nach dem Blühen wächst der Kelch bis auf das Doppelte zu und erreicht eine Länge von 4,5 mm mit 2 mm langen Zipfeln. Der Kelchtubus ist also länger als die Kelchzipfel, was für diesen Typus sehr charakteristisch ist. Dieser Tubus ist ferner 5kantig, eiförmig zylindrisch, mit 10 scharf vorspringenden Nerven. Längs den Nerven stehen in Reihen kurze, aber kräftige, $^1/_4$—$^1/_2$ mm lange, winkelrecht abstehende Hakenhaare auf einer braunen, angeschwollenen Haarbasis. Die Kelchzipfel sind gerade und stehen ein wenig offen.

Die Frucht finde ich in der Regel in Korrelation zu dem vergrösserten Kelchtubus ein wenig grösser als gewöhnlich, 1,3—1,5 × 0,8—1 mm, eiförmig bis oval.

Die sphärischen Pollenkörner zeigen einen Durchmesser von 17—19 μ.

Unterscheidungsmerkmale. — Stengel hochgewachsen, vielblättrig, sperrhaarig; Korolle sehr klein, weiss bis blassblau, mit halboffenem Saum; Kelchtubus länger als die Zipfel, mit vorspringenden Nerven und zahlreichen kurzen, starken Hakenhaaren.

Variationen habe ich nicht viele gesehen. Exemplare mit mehr oder weniger angedrückt behaartem, unterem Stengelteil liegen von den Färöern vor. An einem Exemplar aus Madeira sind die Kelchzipfel länger als die Kelchröhre. Bis auf weiteres ziehe ich vor, auch diesen Typus als Subspezies aufzuführen in Analogie mit den beiden übrigen Typen.

Verbreitung. — Diesen westeuropäischen Typus habe ich auf einem originellen Umwege kennengelernt. Frau Elisabeth Ekman, die bekannte schwedische Forscherin in den Gattungen *Draba* und *Antennaria* etc., übergab mir eine kleine *Myosotis* mit reifen Früchten, die ihr eine Freundin aus Punta Arenas in Patagonien unter anderen Pflanzensamen gesandt hatte. In Topfkultur blühte die Pflanze schon nach 2 Monaten, und nach Auspflanzen in meinem Schulgarten bei der Wasa Realskola entwickelten sich die Pflanzen sehr kräftig. Sie zeichneten sich durch ihre ganz eigenartige Verzweigung aus, indem die basalen Seitenzweige niederliegend bis aufsteigend waren. An den nicht so gut ernährten spontanen Exemplaren ist dies nicht zu sehen. Schon im Herbste desselben (vorigen) Jahres keimten die Samen und entwickelten zahlreiche Rosetten, die zum Teil überwintert haben und schon (im April) Knospen trugen. Wie bekannt, kann *M. versicolor* sowohl sommer- als winterannuell sein.

Die Fruchtstellungen blieben an den kultivierten Exemplaren rein grün. Die minimalen Blütenkronen waren anfangs rein weiss, dann blassblau mit aus dem Kelche nicht oder sehr wenig hinausragendem Tubus und tütenförmig zusammenstehenden Saumzipfeln. Wie es immer bei *M. versicolor* der Fall zu sein scheint, war die Kronenröhre schon in der Knospe lilafarbig. Da *M. versicolor* in Amerika eine aus Europa eingeführte Adventivpflanze ist, lag es nahe, nach der Pflanze in den europäischen

Herbarien zu forschen. Die durch den sperrhaarigen Stengel, den langen Kelchtubus, die kleinen Kelchzipfel und die kleinen Blütenkronen leicht kenntliche Pflanze war auch in einer Anzahl Exemplaren von den Färöern, aus Frankreich, Grossbritannien, Spanien und Norditalien vorhanden. Sie dürfte also eine westeuropäische (atlantische) Verbreitung haben. In den *Mysotis*-Sammlungen des Gray-Herbariums in Cambridge Mass. lag die Ssp. *dubia* als Adventivpflanze noch von mehreren Plätzen der Vancouver-Insel in Nordamerika vor. Aus den skandinavischen Ländern habe ich diesen Typus nicht gesehen.

Folgende Fundorte habe ich für *M. versicolor* ssp. *dubia* verzeichnet.

Färöer.

Strömö: Sandegjerde ved Thorshavn, C. A. Feilberg & E. Rostrup 1867; Suderö: Lopra, Ove Poulsen 1903; ibid., in agris inter Tvärå et Trangisvåg, H. G. Simmons 1895; ibid., Frodebö, J. Hartz & C. Ostenfeld 1897; Nolsö: C. A. Feilberg & E. Rostrup 1867 (alles aus Herb. Stockh.).

Schottland.

Montrose, E. Poulsson 1882 (Herb. Stockh.).

England.

Bath, from Charles C. Babington (Herb. Upsal.); Norfolk: Filby 1908, G. Claridge Druce n. 182 (Herb. Stockh.).

Frankreich.

Calvados: sables du marais de Deauville, D. D. 1843, Herb. E. Cosson; Eure: Forêt d'Evreux 1908, P. Fournier (soc. ssp. *longicalyx,* sub nom. *M. dubia* Arrondeau; Herb. Stockh.); Orne: rochers de Mont Milvent, D. D. 1846, Herb. E. Cosson; Vienne: moissons des terrains argilo-silicieux à Pindray près Montmorillon, T. Chaboisseau 1860, reliquiae Mailleanae 128 (alles aus Herb. Stockh.).

Italien.

Toscana, Herb. Horti Pisani (zusammen mit einer *M. versicolor* f. calyce minuto =? *M. versicolor* var. *caprariae* Béguinot, Annali di Botanica I, 1904, p. 294).

Spanien.

Leg. Gussone (Name des Ortes unleserlich, Herb. Stockh.); Burgos: S:ta Gadea, champs, Hno. Elias 1921, Sennen 4342 (Herb. Degen).

Madeira.

Ribera da Janella, in D:a Vicencias garden, a weed, R. T. Lowe 1865 (die Kelchzipfel verlängert; Herb. Stockh.).

Südamerika.

Chile: Punta Arenas, curante Elisabeth Ekman 1929 (Herb. Stockh.).

Nordamerika.

British Columbia, Vancouver Island: Deep Bay, Saanich, damp ground, clearing, W. R. Carter 1918; ibid., near Spront Lake, C. O. Rosendahl 1906; ibid., near coal mines, Nanaimo, C. O. Rosendahl 1907; ibid., vicinity of Nanaimo, John Macoun 1893 (alles aus Gray Herb.)

Literaturzitate und Bemerkungen.

(1) Ein im unteren Teil beblätterter Blütenstand kennzeichnet ausser *M. lutea* *M. laxa* Lehm. (=*caespitosa* Schultz), *M. pusilla* Lois. und *M. stricta* Link. An dem kräftigen Hauptstengel sind zwar Blätter und Blüten oft getrennt, aber der Blütenstand setzt nahe an der Basis des Stengels an. An den kleineren Seitenzweigen und an wenigblütigen Zwergexemplaren ist der Blütenstand in der Regel hoch hinauf beblättert. Auch an *M. versicolor* findet sich bisweilen eine schwache Beblätterung des Blütenstandes an den Seitenzweigen und an Zwergindividuen. Am Hauptstengel ist jedoch hier in der Regel ein blattloser Streifen zwischen Blatt- und Blütenregion. Der Charakter »beblätterter Blütenstand» ist also mit einem zweiten Charakter: »der Blütenstand beginnt nahe an der Basis des Hauptstengels» kombiniert. So ist es gerade bei *M. lutea*. Dies wird bei Willkomm & Lange (6) folgendermassen ausgedrückt: racemis nudis demum valde elongatis caule ipso longioribus. — (2) Cavanilles, A. J., Icones et descriptiones plantarum I p. 50, tab. 69 fig. 1, Matritii 1791 (zitiert nach Schinz & Thellung, 3). — (3) Schinz, H. & Thellung, A., Bull. Herb. Boiss., 2:me sér., VII p. 388, 1907. — (4) Persoon, C. H., Synopsis plantarum I p. 156, Parisiis Lutetiorum 1805. — (5) Hoffmannsegg, J. C. & Link, H. F., Flore portugaise, Tome I p. 173, Berlin 1809. — (6) Willkomm, M. & Lange, J., Prodromus Florae Hispanicae II p. 504, Stuttgartiae 1861. — (7) Fiori, A., Nuova flora analitica d'Italia, Vol. II p. 277, gibt bei *M. arvensis* ε *versicolor* an: »rr. quasi esclusivam. gialla = f. Balbisiana (Jord.)», jedoch ohne Lokalangabe. In Hegis Flora (11) sagt H. Gams bei *M. lutea* var. *Balbisiana:* »angeblich auch in Oberitalien.» Béguinot, Materiali per una Monografia del genere Myosotis L., Annali di Botanica, Vol. I. Roma 1904, hat keine Angabe darüber. Beiläufig sei bemerkt, dass es, auch mit dem allerweitesten Artbegriffe, verfehlt ist, mit Fiori *M. versicolor* unter *M. arvensis* zu stellen. Schon die grosse Verschiedenheit der Pollenkörner: bei *M. arvensis* biskuitförmig, bei *M. versicolor* von normaler sphärischer Gestalt, verweist die Arten sogar in verschiedene Untergattungen. — (8) Jordan, A.,

Pugillus plantarum novarum, p. 128, Paris 1852. — (9) Rouy, G., Flore de France X p. 327, 1908. — (10) Balbis, G. B., Flore Lyonnaise p. 495, Lyon 1827. — (11) Hegi, G., Illustrierte Flora von Mittel-Europa V, 3 p. 2175, 1926. — (12) Smith, J. E., English Botany, Vol. XXXVI, 1814, nach dem Texte zu Tab. 2558 als Berichtigung zu Tab. 480 Fig. 1. — (13) Boreau, A., Flore du centre de la France, Tome II p. 463, Paris 1857. — (14) Von dieser Form liegt ein Exemplar im Herb. Stockh. unter dem Namen *M. Lloydii* Corbière, Forêt d'Evreux (Eure), P. Fournier 1908. — (15) Überhaupt muss man sich hüten, in einer formenreichen Art ohne weiteres nur eine Reihe Charakterkombinationen (Isoreagenten) zu sehen. Dies stimmt nicht immer zu der Wirklichkeit. Bei einer vorurteilsfreien Prüfung findet der Artsystematiker oft in der polymorphen Art fixe Typen höheren Ranges, die eine ganze Reihe konstant anwesender Charaktere besitzen, Typen, die weit verbreitet sind oder eine eigene geographische Verbreitung zeigen, und deren Charaktere sich gut auch in den Zwischenformen erkennen lassen. Dabei kann man oft mit Vorteil von mehr oder weniger ambulatorischen Isoreagentencharakteren absehen.

Eine in gewissem Grade fehlerhafte Auffassung findet sich oft betreffs der linneanischen Arten. Die Arten sind ja keineswegs gleichwertig und stehen nicht in gleichem Abstande voneinander in einer schön symmetrischen Reihe. Linné hielt sich an die in der Natur gegebenen Typen und hatte im grossen und ganzen, oder sagen wir im Prinzip, denselben Artbegriff wie wir. Nur war die Art bei ihm oft (oder bisweilen) weiter gefasst, weil sie damals noch nicht detailliert studiert worden war, so wie der Tropensystematiker oft noch in unsern Tagen aus praktischen Gründen die Art auffassen muss. In vielen Fällen aber war die Artauffassung Linnés enger als in modernen Floren, und mehrere seiner Arten wurden von seinen Nachfolgern eingezogen. Erst in der letzten Zeit sind einige dieser Arten wieder zu ihrem Recht gekommen (oder verdienen es wenigstens), wie *Poa angustifolia* L., *Phleum nodosum* L., *Agrostis stolonifera* L., *Chenopodium viride* L., *Antirrhinum* (= *Linaria*) *monspessulanum* L., *Centaurea amara* L., *Salix arenaria* L.

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THE CYTOLOGY OF THE GENUS PRIMULA.

(A PRELIMINARY REPORT.)

BY

H. G. BRUUN

UPPSALA.

The extensive genus *Primula,* on the one hand constituting an undoubtable unity, on the other hand comprising more than 30 mostly well defined and clearly distinguishable sections, is specially adapted for the elucidation of the relation between taxonomy and cytology in a genus. Valuable work on this subject has been published lately, proving disparity in this respect in different parts of the vegetable system. Now, *Primula* has been found to be intermediate between one extreme, where (as in *Lilium*, *Fritillaria*, and *Tulipa*) the same karyotype is common to different though related genera, and the other, where even closely related species of the same genus differ with respect to their idiograms.

In *Primula* the section coincides as a rule with the karyotype, a fact which supports the view that the difference between the above-mentioned extremes is not fundamental, but is only a difference of degree. Some cytological changes are followed by important morphological changes and others by hardly noticeable external differences; therefore the variation of morphological and karyological characters cannot be expected to run quite parallel in different parts of the system, not even in the same genus.

The fact that in *Primula* important karyological characters as a rule remain constant within a section confirms both the reliable taxonomic work on this genus of W. W. Smith and Forrest (1929), and the cytological methods employed. Some exceptions

are, however, found, and it is a point of some importance that these cases seem to agree with the taxonomic view held by the preceding reviser of this genus, B. Balfour (1913). The following list of chromosome numbers is therefore the taxonomic system of W. W. Smith and Forrest (1929). Two of Balfour's sections, *Auriculata* and *Yunnanensis,* now merged in the comprehensive and polymorphous *Farinosae,* have been revived as a suggestion to give a better illustration of the cytological dissimilarities in this now certainly heterogeneous section. *P. Inayatii,* undoubtedly not of Nivalid relationship, has by way of proposal been placed by itself, its idiogram differing from all other known Primulas. A subsection arrangement is proposed in some cases, where smaller cytological differences are present within a section, and a subgenus classification is attempted, based on chromosome size and shape (length in proportion to width), since these characters are considered to be most constant. This arrangement is preliminary and tentative, as the macro-morphological characters have not been considered.

The chromosome numbers found are:

		n	2n
Subgenus 1, Section Grandis.			
	P. grandis		44
Subgenus 2, Section Auricula.[1]			
	P. Auricula		56?
	P. marginata		90?
	P. hirsuta		64?
	P. glaucescens		56?
	P. minima		64?
Subgenus 3, Section Verticillata.			
	P. floribunda		18
	P. verticillata		18
	P. »Kewensis»		36
	» » (back-crosses)	different numbers	
Subgenus 4, Section Vernales.			
	P. Juliae		22
	P. vulgaris		22
	P. heterochroma		22
	P. leucophylla		22
	P. elatior		22

[1] The *Auricula* section, contrary to the rest of the genus, has not given satisfactory results with the fixative employed (Navashin). As this section is subjected to special investigations from another quarter, very little attention is paid to my own numbers.

		n	2n
	P. pseudoelatior		22
	P. veris		22
	P. macrocalyx		22
	Several species-crosses		22
Section Megaseaefolia.			
	P. megaseaefolia		22
Subgenus 5, Section Cortusoides.			
Subsection Geranioides.			
	P. heucherifolia		22
	P. geraniifolia		22
	P. latisecta		22
Subsection Septemlobae.			
	P. Maclarenii		24
	P. septemloba		24
	P. mollis		24
	P. seclusa		24
Subsection Paulianae.			
	P. Pauliana		24
Subsection Eu-cortusoides.			
	P. cortusoides		24
	P. saxatilis		24
	P. Sieboldii		24
	P. polyneura		24
	P. lichiangensis		24
	P. Veitchii		24
Section Reinii.			
	P. Reinii		24
Section Pycnoloba.			
	P. pycnoloba		24
Section Obconica.			
	P. obconica	12	24
	P. sinolisteri		24
	P. Werringtonensis		24
Section Sinenses.			
	P. calciphila		24
	P. sinensis		24
	» var. *gigas*		48 ?
Section Malacoides.			
	P. malacoides	9	18
	P. effusa		18
	P. Forbesii		18
Subgenus 6, Section Bullatae.			
	P. Forrestii		24
	P. rufa		24
	P. redolens		24
Subgenus 7, Section Petiolares.			
	P. Winteri		22

		n	2n
Subgenus 8, Section Nivales.			
A.	*P. leucops*		44
	P. Ellisiae		44
	P. Parryi		44
	P. Rusbyi		44
B.	*P. Maximowiczii*		22
	P. tangutica		22
	P. szechuanica		22
	P. obliqua		22
C.	*P. macrophylla*		22
D.	*P. russeola*		22
	P. sinoplantaginea		22
	P. melanops		22
	P. chionantha		22
	P. Purdomii		22
Section Rotundifolia.			
	P. Gambeliana		22
Section Candelabra.			
A.	*P. ianthina*		22
B.	*P. Morsheadiana*		22
	P. melanodonta?		22
	P. serratifolia		22
	P. Beesiana	11	22
	P. burmanica	11	22
	P. aurantiaca		22
	P. Bulleyana	11	22
	P. Cockburniana		22
	P. chungensis		22
	P. pulverulenta		22
	P. japonica		44
	P. Miyabeana		22
	P. imperialis		22
	P. helodoxa		22
	P. Smithiana	11	22
	P. anisodora		22
	P. Poissonii		22
	P. Wilsonii		22
Section Sikkimensis.			
A.	*P. vittata*		22
	P. secundiflora		22
B.	*P. Waltonii*		22
	P. prionotes		22
	P. Florindae		22
	P. microdonta alpicola		22
	P. microdonta violacea		22
	P. firmipes		22
	P. flexilipes		22

		n	2n
	P. sikkimensis		22
	P. pseudosikkimensis	11	22
	P. pudibunda		22
Subgenus 9, Section Capitatae.			
	P. capitata		18
	P. crispata		18
	P. lacteocapitata		18
	P. Mooreana		18
	P. sphaerocephala	9	18
Section Denticulata.			
	P. denticulata	11	22
	P. erythrocarpa		22
	P. crispa		44
Section Muscarioides.			
	P. cernua		20
	P. Menziesiana		40
	P. bellidifolia		20
	P. atricapilla		20
	P. lepta		40
	P. pinnatifida		20
	P. apoclita		40
	P. muscarioides		40
	P. deflexa ?		40
	P. cyanantha		40
	P. Littoniana	10	20
Section Soldanelloideae.			
	P. nutans		20
	P. Reidii		20
Subgenus 10, Section Cuneifolia.			
	P. suffrutescens		44
Section Inayatii.			
	P. Inayatii.		16
Section Auriculata.			
A.	*P. algida*		44
	P. luteola		44
B.	*P. rosea*		22
	P. elliptica		22
Section Minutissimae.			
	P. reptans		22
Subgenus 11, Section Souliei.			
	P. rupicola		16
Section Farinosae.			
Subsection Stenocalyces.			
	P. stenocalyx		16
	P. blandula		16
	P. Knuthiana		16
	P. caldaria		16

	n	2n
Subsection Eu-farinosae.		
P. Fauriei		18
P. farinosa	9	18
P. farinosa Warei		72
P. exigua		18
P. magellanica		72
P. scotica		54
P. scotica scandinavica		72
P. stricta		126
P. longiflora		36
P. frondosa		18
P. farinifolia		18
P. capitellata		72
Subsection Sibiricae.		
P. sibirica		22
P. involucrata		44
P. chrysopa		20
P. yargongensis		20
P. tibetica		20
P. fasciculata		18
Subsection Glabrae.		
P. Genestieriana		16
P. glabra		16
Section Yunnanensis.		
P. yunnanensis		22

The general regularity of these numbers is undeniable. The sections are characterized by a certain basic number, by chromosome shape and size, and often by satellites and constrictions, *i. e.* by their karyotypes. In certain cases, where the border between different sections is rather indistinct, *e. g. Capitatae - Denticulata - Muscarioides*, the basic number, being in this case 9, 11, and 10 respectively, will give a clear decision as to which section a certain species belongs. In other cases, where the actual basic number is common to two sections, another cytological character, such as chromosome size etc., becomes a distinguishing feature. Very few sections cannot at all or only with uncertainty be distinguished cytologically one from the other. These cases are: *Sinenses* from *Eu-cortusoides*, *Soldanelloideae* from *Muscarioides*, and *Rotundifolia* from *Nivales*. All the other sections are clearly separable; they constitute one unique karyotype, although this karyotype may show different facies in some larger sections through

variation of some minor characters. These facies may preliminary be tentatively considered as a structural basis for a subsection classification.

The comprehensive section *Farinosae* is an exception in this respect. Its numerous species, it is true, are easily grouped to karyotypes, which show smaller variations into different facies, but some of this karyotypes have practically no feature in common. As far as I can see the only solution of this problem is, as already indicated above, that *Farinosae* in its present taxonomic position is of heterogeneous origin, since the conformity with the rest of the genus is restored, if this aggregate is divided into smaller sections. The sections grouped round *Farinosae* offer, however, many difficulties for the cytologist as well as for the taxonomist; certainly this is due to the fact that the elimination of intermediate forms through natural selection has not proceeded far in this polymorphous group.

Comparison between taxonomic importance of different cytological characters.

The species of a section have, as indicated above, seldom identical nuclei; on the contrary these vary often in one or more details, though their affinity is obvious. It is possible hereby to obtain knowledge of the relative stability of different cytological characters, and therefore also to estimate their taxonomic value. The most stable characteristics have proved to be medium size (a certain variation must always be admitted) and shape (length in proportion to width) of the chromosomes. The subgenus classification outlined above is therefore based on these characters. Next in significance are the size of the chromosomes in relation to each other (relative unevenness of size), the basic number, and the appearance of the constrictions (abruptly cut off or drawn out), which characters are important for distinguishing sections. Polyploidy only separates species or subspecies (in *Nivales* possibly an American subsection). A minimum of stability is according to my experience shown by the place of the constrictions and the satellites, as somatic nuclei in many cases, though restricted to certain species or groups of species, are asymmetrical in this respect (Bruun 1930 *a*, *b*).

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Den stora fattigdomen på eller helt avsaknaden av lavvegetation — även om dennas vanliga substrat förefinnes — i större städer, vid stora fabriksanläggningar o. dyl. är en sak, som länge varit uppmärksammad av lichenologerna och vars orsaker även diskuterats, för första gången antagligen av Nylander 1866 i hans arbete »Les Lichens du Jardin du Luxembourg». Någon mera vidlyftig detaljundersökning inom detta område har emellertid icke förefunnits, varför en nyligen utkommen sådan rörande trädlavvegetationen inom staden Oslo med närmaste omnejd är värd all uppmärksamhet. Förf. till arbetet är lektor Pål K. Haugsjå, Skien.

Förf. har indelat sitt arbete i trenne avdelningar. I den första och mest omfattande lämnas en skildring av lavvegetationen på de 126 stationer i Oslo och närmaste omgivning, förf. undersökt. Med station, som alltså är enhet vid undersökningen, avses en större isolerad trädgrupp (park, kyrkogård, allé o. dyl.). Alla stationer ha belagts med nummer och namn (t. ex. 1. Studentlunden och Universitetshagen, 2. Slottsparken, 3. Akershus o. s. v.). Varje dylik lokal beskrives, och de olika lavarterna anföras efter trädslag och med täckningsgraden angiven, tydligen enligt uppskattning (efter en sjugradig skala; den verkliga skillnaden mellan de två lägsta graderna, som för övrigt icke som de andra uttryckts med siffror, är mig icke fullt klar). Förf. har för de flesta stationer sökt åskådliggöra lavvegetationens täckningsgrad även på ett annat sätt, enligt en slags linjetaxeringsmetod. Tillvägagångssättet var följande. Ett representativt träd utvaldes som typ för stationen ifråga. Omkretsen vid 0,5 m ovan marken uppmättes. Därpå antecknades, huru många cm av omkretsen varje art täckte. Samma förfaringssätt vid 1,5 m ovan marken. På så vis kan lätt uträknas, huru många procent av de båda omkretsarna som täckas av lavar (och mossor), varigenom en ungefärlig bild av lav- (och moss-) betäckningen på stammen erhålles. Exaktheten skulle naturligtvis ökats betydligt — ävensom arbetet —, om undersökningscirklarna lagts på t. ex. en eller några få dm:s avstånd från varandra från basen av stammen till den höjd, där lavvegetationen upphör. Kanske att i verkligheten skillnaden icke blir så stor, som man åtminstone teoretiskt kan tänka sig (det gäller här trädstam med tämligen likformigt fördelad lavvegetation), men detta

borde ha prövats. Förf. framhåller dock själv den ungefärliga bild av lavbetäckningen, som den av honom använda metoden lämnar; men en noggrannare metod skulle givetvis varit av värde för en undersökning som den ifrågavarande. Förf. beklagar själv, att han på grund av bristande tid blott kunnat undersöka ett träd på varje station.

Av de nämnda analyserna framgår tydligt, vilket ju även är att vänta, att lavvegetationen å de i stadens centrum belägna stationerna är ytterst sparsam eller saknas. Protococcaceer äro där de viktigaste eller enda epifyterna. Minst kinkig av lavar är *Lecanora Hageni*, därnäst *Physcia tribacia* och *Candelaria concolor*. Antalet lokaler inom staden för dessa tre nämnda arter är resp. 16, 11 och 9. I dåligt utvecklade exemplar förekomma även rätt långt in i staden *Parmelia physodes, P. sulcata, Physcia stellaris, Ph. virella, Xanthoria polycarpa* m. fl. Längre bort från centrum blir lavvegetationen rikare och artantalet större.

I nästa avdelning av arbetet behandlas de 25 viktigaste lavarterna och deras uppträdande inom området. Inre gräns och normalgräns angivas för de olika arterna. Uppgift om storleken av iakttagna exemplar m. m. anföres.

Slutligen avhandlas de faktorer, som framför andra bestämma lavvegetationens utveckling inom ett område sådant som det ifrågavarande. De äro ljus, fuktighet, stoftimpregnation samt rök och gaser. Det är särskilt stenkolsröken, den ofta alltför starka stoftimpregnationen och de i en storstad sämre ljusförhållandena, som verka hämmande på lavarnas utveckling, vilket även av tidigare författare framhållits. Förf. urskiljer i Oslo med omnejd efter Sernander (i »Stockholms Natur», sid. 160) trenne zoner med avseende på lavvegetation: 1. lavöknen (utan lavar), 2. kampzonen (tämligen sparsam lavvegetation av endast nitrofila arter) och 3. normalzonen (med normal lavvegetation). Förf. har i slutet av arbetet 20 st. kartor utvisande lika många arters absoluta innergränser och deras normalzoners innergränser. På varje karta äro även öken-, kamp- och normalzonerna markerade, ävensom stadsgränsen. Därav framgår, att staden Oslo icke når utanför kampzonens område. Det är t. o. m. långt från stadsgränsen till normalzonens inträde (i allmänhet enligt vad som framgår av kartorna c:a 2,5 km). Lavöknen omfattar den tätast befolkade delen av staden med hamnen och de äldsta partierna. — Genom en samling lavar, som åren 1840—70 hopbragts inom staden av N. G. Moe och M. N. Blytt och vilken förvaras på Botaniska museet i Oslo, kan man få en uppfattning om lavvegetationens förändring sedan den nämnda tiden. Sålunda visar det sig, att normalzonens inre gräns sedan 1840 förskjutits 4—5 km utåt. Den skulle med andra ord för 90 år sedan ha berört den nuvarande stadens område. Förf. anför Arnolds liknande iakttagelser från München (»Zur Lichenenflora von München», 1892, sid. 28—30).

Apotheciebildningen hämmas inom stadens område. Av de 29 lavar, förf. funnit innanför stadsgränsen, ha endast 2 iakttagits med välutvecklade apothecier (*Cladonia coccifera* och *Lecanora Hageni*). Med deformerade apothecier ha dock iakttagits några andra arter, t. ex. *Xanthoria polycarpa* och *Physcia stellaris* (sporerna äro välutvecklade). En rikare isidie- och sorediebildning, som man möjligen skulle kunnat vänta

sig i stället, har förf. icke med säkerhet kunnat konstatera. Förf. påpekar vidare, att lavarna inom staden visa tendens att växa vid basen av träden, även om de annars icke förhålla sig på detta sätt. Så t. ex. förekommer *Physcia tribacia* sällan över 0,5 m ovan marken inom stadens område.

Det intressanta arbetet avslutas med en del upplysande tabeller och de nämnda kartorna. *Gunnar Nilsson.*

Antevs, E., The Last Glaciation. — Amer. Geogr. Soc., Research Series No. 17, New York 1928.

Woldstedt, P., Das Eiszeitalter. Grundlinien einer Geologie des Diluviums. — F. Enke, Stuttgart 1929.

De nya metoderna för undersökning av fossilförande jordarter ha i hög grad ökat möjligheterna att följa växtvärldens historia inom de områden, som varit utsatta för de kvartära nedisningarna. Man riskerar lätt att på ett eller annat sätt alltför ensidigt tillämpa de därvid vunna resultaten. Detta gäller till exempel om pollenanalysen, där man — jag skulle nästan vilja säga som regel — skrivit alltför mycket på klimatets konto och tillgripit »klimatförändringar» som ett svagt substitut för förklaringar, som ofta kunde ha sökts på andra håll.

En tillförlitlig utredning av kausalsammanhanget mellan de kvartära fenomenen kan väl först uppnås, om man beaktar alla de geobiologiska disciplinerna och detta helst ur såväl historisk som aktuell och experimentell synpunkt. För en orientering över kvartärtidens geologi, som ju måste ligga till grund för all kvartärgeologisk forskning, kunna ovan anförda arbeten av Antevs och Woldstedt varmt rekommenderas. Antevs' arbete innehåller en utmärkt redogörelse för den sista nedisningen, medan Woldstedts innehållsrika, kritiskt refererande och väl illustrerade arbete behandlar kvartärtiden som helhet. Båda arbetena innehålla kortfattade redogörelser för nedisningarnas inverkan på växtvärlden. De många tabellariska sammanställningarna av avsmältnings-, resp. framryckningsfaser, nivåförändringar, klimatförskjutningar, arkeologisk utveckling etc. underlätta givetvis översikten, men ge lätt sken av att förhållandena skulle vara bättre kända, än vad de i verkligheten äro. *G. Erdtman.*

Charlesworth, J. K., Some Geological Observations on the Origin of the Irish Fauna and Flora. — Proc. Roy. Irish Acad., XXXIX B, 358—390, 1930.

Irlands flora och fauna omfattar som bekant många arter (amerikanska, lusitaniska o. s. v.), vilkas invandringshistoria ännu är så gott som okänd. Detta beror nog delvis på bristande samarbete mellan geologer och biologer. Det är därför glädjande, att professor Charlesworth med föreliggande avhandling givit en kritisk framställning av just de drag av Irlands senkvartära geologi, som varit avgörande för landets biologiska utveckling.

Vid höjdpunkten av »den stora nedisningen» var hela det nuvarande Irland täckt av is, som i nordost och i öster sammanhängde med Storbritanniens is. I övrigt sträckte sig isen fram mot eller möjligen ut över den dåtida kustlinjen, som låg mellan 15 och 100 km utanför den nutida. Särskilt härdiga preglaciala element kunna möjligen ha levat kvar under

den stora nedisningen på isfria sträckor utanför den nutida kustlinjen i söder.

Under klimatförbättringen under den följande »aurignac-oscillationen» drog sig isen tillbaka till den centraliriska slätten i norr. De brittiska öarna voro då sammanbundna sinsemellan samt med kontinenten, vilket möjliggjorde invandring bl. a. av den fauna, som man känner rätt väl genom grottfynd i södra Irland.

Efter aurignac-oscillationen följde en sista nedisning (»Early Magdalenian glaciation»), under vilken isen sköt fram mot söder till den stora sydiriska ändmoränlinjen. Härvid gick sannolikt en mycket stor procent av aurignactidens element under, och flertalet av Irlands växter och djur måste sålunda ha inkommit under den postglaciala tiden. Under denna tid ha strandförskjutningar ägt rum, vilka först medförde en ökning, senare en minskning av landarealen. Landarealens ökning åstadkom emellertid troligen ej någon bred och stabil förbindelse med Storbritannien. Det område, som nu intages av Irländska sjön, torde sålunda aldrig helt ha varit land. Det liknade sannolikt ett stort estuarium eller deltaområde, som här och där, särskilt väster om Isle of Man, hade många sjöliknande utvidgningar. Detta jätteträsk begränsades av flacka landbryggor, som från Nordirland sträckte sig över till Skottland, resp. från Sydirland till Wales. De genomdrogos sannolikt av breda, meandrande flodarmar eller sund och förstördes snart av vågor och tidvattenströmmar.

Här kan tilläggas, att södra delen av Nordsjöområdet sannolikt hade en liknande topografi under motsvarande tid. Stora vidder upptogos av grunda haff med nehrungen, av deltan och estuarier, av flygsandsdyner, saltängar, vassar och videkärr.

G. Erdtman.

Svensk Botanisk Tidskrift. 1930. Bd. 24, H. 3.

DEN 5. INTERNATIONELLA BOTANISTKONGRESSEN I CAMBRIDGE DEN 16—23 AUGUSTI 1930.

Den femte internationella botanistkongressen i Cambridge 1930 var den talrikast besökta botaniska kongress, som någonsin hållits, med över 1 200 anmälda deltagare från nästan hela världen, bland dessa bortemot ett 20-tal svenskar. De flesta kongressdeltagarna inlogerades i den gamla universitetsstadens förnäma colleges, vilka stodo lediga under ferierna och erbjödo utmärkt komfortabla bostäder.

President för kongressen var den framstående paleontologen professor A. C. Seward, föreståndare för Cambridge's botaniska institut, Botany School. Bland de 28 vicepresidenterna för hela kongressen märktes professor Juel. Sveriges officielle representant var professor Svedelius. Förhandlingarna voro förlagda dels till allmänna sammanträden, dels, och framför allt, till de olika sektionerna. Kongressens speciella förhandlingar voro uppdelade på följande 8 olika sektioner, nämligen 1) för bakteriologi, 2) för växtgeografi och ekologi, 3) för genetik och cytologi. 4) för morfologi och anatomi, 5) för mykologi och växtpatologi, 6) för växtfysiologi, 7) för växtpaleontologi samt 8) för taxonomi och nomenklaturfrågor. Varje sektion hade jämte sin ordförande några vice ordförande. Följande svenskar tjänstgjorde under kongressen som ordförande och vice ordförande i sektioner: professor Rosenberg, ordförande i sektionen för genetik och cytologi; professor Svedelius, v. ordförande i sektionen för morfologi; professor Lundegårdh, v. ordförande i sektionen för växtfysiologi; professor Halle, v. ordförande i växtpaleontologiska sektionen samt professor Rob. E. Fries, v. ordförande i taxonomi- och nomenklatursektionen. Sverige var således hedrat genom en talrik representation i presidiet.

Förhandlingarna i de enskilda sektionerna hade i allmänhet planlagts så, att vissa på förhand uppställda frågor diskuterades, varvid specialforskare särskilt inbjudits att hålla inledningsföredragen och från olika ståndpunkter belysa problemen. Härigenom åstadkoms på en och samma dag en serie av föredrag av olika föredragshållare över ett gemensamt ämne, ett s. k. symposium. Endast genom en dylik anordning kunde vid en så stor kongress föredragen begränsas till vissa bestämda frågor och problem av större allmän betydelse, enär annars, därest varje deltagare skulle ha tillåtits att hålla föredrag över skilda ämnen, det hela skulle ha resulterat i en mängd olikartade specialföredrag, ofta kanske utan inbördes sammanhang. Såsom exempel på dylika frågor, som behandlades, må anföras, att växtgeografiska sektionen diskuterade vegetationens postglaciala förändringar i nordvästra

Europa i förhållande till dem i det övriga Europa, varvid ett av inledningsföredragen hölls av professor von Post. Samma sektion diskuterade även principerna för vegetationens klassificering och därmed i samband stående nomenklaturfrågor, varvid ett av inledningsföredragen hölls av docenten Du Rietz. Tillsammans med systematikerna diskuterade även växtgeograferna artbegreppet i dess förhållande till den geografiska utbredningen, varvid docenten Turesson höll ett av inledningsföredragen. Vidare diskuterades frågan om enhetliga principer för kartläggning av enskilda arter och växtsamhällen liksom frågan om standardisering av beskrivningar på växtsamhällen m. fl. dylika frågor. Slutligen ägnades en hel dag åt ett symposium över Europas bokskogar, varvid bland de 11 inledarna märktes kand. B. Lindquist, som höll ett föredrag om bokskogarna i Sverige.

Sektionens för cytologi och genetik förhandlingar inleddes med ett föredrag av professor Rosenberg om riktlinjerna för den moderna cytologiens utveckling och dess uppgifter. Därefter diskuterades sådana frågor som chimära-problemet (tillsammans med morfologerna), mutationerna, cytoplasman som ärftlighetens bärare, polyploidi, kromosommorfologi, varvid kand. H. Bruun höll ett föredrag om kromosomfragmentation hos släktet *Primula*. Vidare behandlades s. k. selektiv befruktning och pollensterilitet, varjämte sektionen hade en med systematikerna gemensam diskussion om artbegreppet.

Sektionen för morfologi och anatomi började sina förhandlingar med en diskussion om »Phytonic Theories», inledd av ordföranden professor Schoute (Groningen), varvid det gamla problemet, hur man skall betrakta stam och blad i deras inbördes förhållande till varandra, diskuterades, i samband varmed man även kom in på frågan om bladets uppkomst m. m. Ett sammanträde ägnades åt utvecklingsmekanik med särskild hänsyn till växtanatomien, åt xeromorfien och det anatomiska xerofytproblemet. Denna sektion diskuterade även Miss Saunders' teori om fruktbladens natur i det synkarpa gynoeceet, en teori, som går ut på att uppfatta fruktämnet såsom bildat av såväl fertila som sterila fruktblad, vilket i allmänhet leder till antagandet av dubbelt så många fruktblad i ett fruktämne mot vad hittills antagits. Teorien rönte motstånd från anatomer som professor Eames och dr Agnes Arber. I samma sektion höll professor Knoll (Prag) ett föredrag om den ekologiska blomanatomiens framsteg. Morfologiska sektionen diskuterade även algernas generations- och fasväxling, varvid professor Svedelius höll inledningsföredraget över florideernas generationsväxling. Chlorofyceerna behandlades av dr Schussnig (Wien), phaeophyceerna av dr Margery Knight (Liverpool) och diatomaceerna av dr Geitler (Wien). I den följande diskussionen gjordes även ett inlägg av professor Kylin. Andra rent anatomiska problem, som behandlades, voro: cellmembranens natur samt meristemen.

Mykologiska sektionen diskuterade bland annat betydelsen av heterotalli och hybridisering bland svampar, om spridningen av rost på sädesslag m. m. Växtfysiologiska sektionen behandlade bland annat kolets ämnesomsättning hos de högre växterna, växtcellens permeabilitet och osmotiska förhållanden, de mineraliska näringsämnenas betydelse för till-

växten hos högre växter, varvid professor LUNDEGÅRDH höll ett inledningsföredrag om spektroskopiska metoder vid studiet av växternas upptagande av mineralisk näring; vidare diskuterades metoder för utforskandet av plasmans organisation, tillväxt och utveckling hos högre växter, kvävets ämnesomsättning hos de högre växterna o. s. v.

Växtpaleontologiska sektionen diskuterade angiospermernas ålder och tidigaste utveckling, den äldsta kända landvegetationen samt pteridospermernas ställning i växtriket, varvid ett av inledningsföredragen hölls av professor HALLE, som även inledde diskussionen om förhållandet mellan de yngsta paleozoiska och de tidigare mesozoiska flororna. Sektionen för

Fig. 1. Kings College och Senatshuset (till höger).

systematik hade ett symposium, som behandlade Kinas flora, en annan diskussion om metoder för systematikens främjande, varvid inledningsföredraget hölls av professor ROB. E. FRIES. Dessutom diskuterade denna sektion, d. v. s. endast de befullmäktigade ombuden för de botaniska institutionerna o. s. v., varje eftermiddag nomenklaturfrågorna. Resultaten, som ratificerades av kongressen på en allmän sammankomst, komma senare att offentliggöras.

Jämte sektionssammanträdena höllos även om kvällarna flera allmänna föredrag. Så höll föreståndaren för trädgården i Buitenzorg dr DOCTERS VAN LEEUWEN ett intressant, av vackra ljusbilder illustrerat föredrag om vegetationen på Javas högsta bergstoppar, professor FERNALD (Cambridge, Mass., U. S. A.) ett om de östliga elementen i nordamerikanska floran samt professor LUNDEGÅRDH ett om kolassimilationen i dess förhållande till ekologien.

Flera fester voro arrangerade i samband med kongressen. Så hade engelske jordbruksministern redan i London före kongressens öppnande en stor officiell mottagning för samtliga kongressens ledamöter i Imperial Institute, varvid tillfälle gavs att stifta bekantskap med de ofta från ett avlägset fjärran anlända kollegerna. Första dagen i Cambridge den 16 aug. gavs en stor mottagning för alla kongressdeltagare i St. John's College, grundlagt år 1511. Gästerna samlades i det s. k. Galleriet, ett ålderdomligt rum med rikt skulpterade träpanelade väggar och tak, i sitt slag ett av de förnämligaste college-rummen, som finnas bevarade i England. Bland porträtten på väggarna märktes bland annat ett av den berömde

Fig. 2. St. John's College.

astronomen Herschel. I den magnifika stora hallen serverades sedan förfriskningar, varvid en gosskör utförde en del sånger. På söndagskvällen var en stämningsfull orgelkonsert anordnad i Kings College's kapell, vilket med sina underbara gamla glasmålningar — bland de finaste i världen — än i dag erbjuder samma anblick som då det blev färdigbyggt år 1515.

En annan dag var kongressen i sin helhet inviterad till »garden party» i Downing College av presidenten, professor och fru Seward. Professor Seward var Downing College's Master, d. v. s. närmast motsvarande våra studentnationers inspektor, och hade såsom sådan sin bostad, the Master's Lodge, inom College's stora område. Samma dag på kvällen var kongressens presidium jämte några andra till ett antal av omkr. 150 personer inviterade till middag i Trinity College, grundlagt av Henrik VIII år 1546. Den magnifika hallen, där middagen serverades utan dukar på de massiva månghundraåriga ekborden, var byggd år 1608, och väggarna pryddes

Scott & Wilkinson, Cambridge, photo.

Fig. 3. Femte internationella botanistkongressen i Cambridge 1930. Gruppbild av presidiet.
Personförteckning se motstående sida!

av flera utmärkta porträtt: i fonden Henrik VIII i full kroppsstorlek, å sidoväggarna bland andra: lord Byron, Isaac Newton och Francis Bacon. Professor Goebel, som intog hedersplatsen bland gästerna, framförde i ett längre tal gästernas tack. I övrigt utövades under kongressen även mera privatim en storartad gästfrihet.

I samband med kongressen utdelade Cambridge universitet även hedersdoktorsgrad åt följande sju botanister, nämligen professor J. Briquet (Genève), professor L. Diels (Berlin), professor Th. Halle (Stockholm), professor L. R. Jones (svenskamerikanare från Madison, Wis. U. S. A.), professor C. J. Schröter (Zürich), professor F. A. F. C. Went (Utrecht) samt, som absens, professor P. A. C. Dangeard (Paris). Hedersdoktorerna mottogo, iförda de röda doktorskåporna och de svarta sammetsbaretterna, sina doktorsdiplom av universitetets vice kansler.

Såväl före som efter kongressen voro en hel del exkursioner och utflykter arrangerade till olika trakter av England särskilt för växtgeograferna, men en hel del även av mera allmänt intresse. Så gavs tillfälle att besöka Darwins hem i Down (Kent), som nu, liksom Linnés Hammarby i Sverige, i England vårdas som ett kulturellt minnesmärke.

En dag efter kongressens slut gjordes ett besök i Royal Botanic Gardens, Kew, vilkas underbara växthus genomgingos under sakkunnig ledning. Smärre grupper besökte vidare John Innes' institut i Merton i London, särskilt bekant genom den berömde engelske ärftlighetsforskaren W. Bateson, dess förste föreståndare. Andra besågo försöksstationer, som Rothamsted Experimental Station, enskilda handelsträdgårdar som Sutton & Sons i Reading, James Carter & Co. i London, R. Horticultural Society's trädgård i Wisley, trädgården i Chelsea m. fl.

Ett särskilt omnämnande förtjäna de utställningar, som i samband med kongressen anordnats såväl i London som i Cambridge. I London var det två utställningar av botaniskt intresse, nämligen dels i Linnean Society's lokaler i Burlington House vid Piccadilly, dels ock i British Museum of Natural History's botaniska avdelning i S. Kensington. Utställningen i Linnean Society omfattade ett 30-tal nummer linnéana. De förnämligaste numren i denna utomordentligt dyrbara samling voro väl Linnés originalmanuskript till hans »Iter Lapponicum» samt till »Species Plantarum». Vidare sågs manuskriptet till hans första offentliga föreläsningar i Botaniska trädgården i Uppsala 1731 liksom manuskriptet till »Iter Dalekarlicum» samt dessutom flera av Linnés egna exemplar av hans tryckta arbeten

Personförteckning till gruppbilden å motstående sida.

Första raden, sittande, från vänster: Harms, Loder, Němec, Went, Schröter, Merrill, Diels, Seward, Wieland, Cowles, Schoute, Domin, Maire, Rendle, Briquet, Prain.

Andra raden, från vänster: Chipp, Stapf, Renier, Gothan, Jongmans, Carter, Rübel, Sprague, Fries, Rosenberg, Svedelius, Gwynne-Vaughan, Pascher, Gates, Jensen, Buchanan, Saunders.

Tredje raden, från vänster: Brooks, Korczewski, Szafer, okänd, F. F. Blackman, Balls, Bertrand, Sahni, Halle, Hill, Murray, Edwards, Winge, Ramsbottom.

Fjärde, bakersta raden, från vänster: Juel, Fritsch, Cotton, Kräusel, Stiles, Briggs, Tansley, V. H. Blackman, Pampanini, Hamshaw Thomas, Godwin, Glück, Dixon, Lloyd.

med egenhändiga anteckningar. Så t. ex. fick man se hans egna exemplar av Species Plantarum, Genera Plantarum, Flora Suecica m. fl.

Bland kuriositeter märktes även ett kuvert till ett brev till Linné från Boerhaave, på vilket Linné antecknat sin adress i London. Som Linné ej kunde tala engelska, har han tydligen under sin Londonvistelse på detta sätt alltid för säkerhets skull burit sin adress på sig. Bland kuriosa

Fig. 4. Trinity College, ingångsportalen.

lade man även märke till ett underbart vackert skulpterat noshörningshorn från Indien, en present till Linné från direktören för Ostindiska kompaniet, kommerserådet M. Lagerström (efter vilken lythracésläktet *Lagerstroemia* uppkallats). Även märktes en promenadkäpp med inristad linnéaranka, som tillhört Linné, den sistnämnda en gåva överlämnad till Linnean Society från Carl Hartman d. yngre så sent som år 1849. Hartman besökte London detta år och besåg då de linnéanska samlingarna och manuskripten (jfr hans uppsatser härom i K. V. A:s Öfversikt 1849, K. V. A:s Handl. 1849, 1851 samt i Bot. Not. 1850) och har han väl då funnit lämpligt att på detta sätt öka de engelska samlingarna av linnéana.

Utställningen i botaniska avdelningen i British Museum omfattade växter och manuskript av historiskt intresse. Där fick man bland annat se växter ur det herbarium, som tillhört Sloane, British Museum's grundläggare; vidare Cliffords växter, vilka legat till grund för Linnés »Hortus Cliffortianus» och som sedermera inköptes från Holland av Banks år 1791; Hermanns växter från Ceylon, som legat till grund för Linnés »Flora Zeylanica»; ett par växter (*Linnaea borealis* och *Astragalus alpinus*), som Linné sänt som gåva till Gronovius och som införlivats med hans herbarium; vidare manuskript av Banks och vår landsman Solander

Fig. 5. Trinity College, gården med springbrunnen.

till ett arbete över Australiens flora; manuskript med teckningar av Schleiden (el. av Schacht), som legat till grund för Schleidens »Grundzüge», samt slutligen de Bary's stora mikroskopiska preparatsamling till fanerogamernas anatomi samt diverse svamppreparat (4,429 nummer!).

Av de historiska samlingar, som utställdes i Botany School i Cambridge, voro kanske de växter, som Darwin insamlade på Galapagosöarna under sin resa runt jorden, av det största intresset.

Hela Cambridgekongressen förlöpte utan alla dissonanser och måste betraktas som synnerligen lyckad och efterlämnar för deltagarna ett odelat angenämt minne. Nästa internationella botanistkongress, som blir den sjätte i ordningen, kommer enligt Cambridgekongressens beslut att avhållas i Amsterdam år 1935. Inbjudningen härtill framfördes å den holländska regeringens vägnar av professor Went (Utrecht).

N. S—s.

NOTISER.

Botanikprofessuren i Uppsala. — Till innehavare av den efter professor O. Juel lediga Borgströmianska professuren i botanik och praktisk ekonomi vid Uppsala universitet har Kungl. Maj:t den 14 augusti 1930 utnämnt och förordnat docenten vid Skogshögskolan, lektorn vid Östermalms Reallärоverk fil. dr. Elias Melin.

Botanisk forskningsresa. — I slutet av juli anträdde professor Thore C. E. Fries, Lund, en botanisk forskningsresa till Afrika. Han åtföljes av sin maka samt amanuenserna Henning Weimarck och Tycho Persson. Expeditionen landsteg i Port Elisabeth för att därifrån begiva sig till Kapstaden. Uppehållet i dessa trakter har beräknats till 2 månader, och färden ställes därefter till de nordöstra delarna av Syd-Rhodesia, som komma att bli det huvudsakliga verksamhetsområdet. Vistelsen där utsträckes till fram mot sommaren 1931. Expeditionens viktigaste uppgifter äro av systematisk och ekologisk art. Även kommer ett stort material för cytologiska undersökningar att insamlas.

Den 9 oktober 1930 inföll hundraårsdagen av den bekante botanisten, professor F. W. C. Areschougs födelse. Han blev adjunkt och botanices demonstrator vid universitetet i Lund år 1858 och utbytte först 21 år senare denna befattning mot professuren i botanik. Från denna post avgick han 1898, men var även därefter och ända till sin död (år 1908) ivrigt sysselsatt med botaniskt forskningsarbete.

Svensk Botanisk Tidskrift. 1930. Bd. 24, H. 4.

CLASSIFICATION AND NOMENCLATURE OF VEGETATION.[1]

BY

G. EINAR DU RIETZ.

The present confusion in the terminology of vegetational units is a fact well known to all ecologists. What a real chaos still prevails in this terminology is clearly shown by Tab. 1, which presents an attempt to parallelize some of the most prominent terminological systems of present-day ecology with each other and with the new compromise-system recently proposed by myself in Abderhalden's Handbuch der biologischen Arbeitsmethoden (Abt. XI, Teil 5). From that table it is easily seen, that even such fundamental terms as »association» and »formation» are still used for quite different concepts by different authors. As this confusion appears to be a serious obstacle to progress and international collaboration in present plant ecology, the attaining of a better agreement in this respect certainly ought to form an important part of the program of any international botanical congress.

In order to simplify the problem and to facilitate the discussion only climax units have been included in the table. Only of the phytocoenoses, or »complete plant-communities», all units of higher and lower rank have been included. To the one-layered elementary communities, or synusiae, into which those phytocoenoses may be dissolved, we shall return later on.

[1] Lecture presented at the Fifth International Botanical Congress (Cambridge 1930), as an introduction to the general discussion on »The Classification and Nomenclature of Vegetation» in the Section for Phytogeography and Ecology (Aug. 19 th, 1930).

Tab. 1. — Comparison of the plant-sociological terminology proposed by G. E.

Examples	G. E. Du Rietz 1928—1930		H. Gams	E. Rübel	H. L. Shantz	G. E. Nich
The *Cetraria islandica*-layer of the alpine *Vaccinium uliginosum - Cetraria islandica*-heath of Middle Europe	Socion (Synusia)		Synusia	Synusia	Society	Society
The alpine *Vaccinium uliginosum - Cetraria islandica*-heath of Middle Europe	Sociation	Phytocoenoses	Phytocoenoses	Sociation	—	—
The alpine *Vaccinium uliginosum*-heath of Middle Europe (with variable bottom-layer)	Consociation			Consociation	—	Consociati
The alpine *Empetrum - Vaccinium uliginosum*-heath of Middle Europe (Braun-Blanquet's *Empetreto-Vaccinietum*)	Association			Association	Association	Associati
The alpine *Loiseleuria - Empetrum - Vaccinium uliginosum*-heath of Middle Europe (Braun-Blanquet's *Loiseleurieto-Vaccinion*)	Federation			(Associations-) Verband	—	—
The Middle-European ericaceous heath (Braun-Blanquet's *Rhodoreto-Vaccinietalia* in somewhat widened sense)	Subformation			Formation	—	—
The boreal ericaceous heath	Formation			—	Formation	—
The boreal, tropical-subalpine, and austral ericaceous heaths, scrubs, and dwarf-forests	Panformation			—	(World) formation group	—
The physiognomic group of lichenous dwarf-shrub heaths	Isocoenoses		Isocoenoses	—	—	—
The physiognomic group of all dwarf-shrub heaths				Formation-group	—	Associatio type
The deflation-complex of the low-alpine morain-ridges	Mosaic-complex	Phytocoenose-complexes	—	—	—	Associatio complex (physiographic formatio
The *Loiseleuria - Empetrum - Vaccinium uliginosum*-region of the low-alpine belt of the Alps	Vegetation-region		Gebiet	Vegetationsstufe	Formation	Climatic formatio

ETZ 1930 with some terminological systems of present plant-sociological literature.

. Cockayne	F. E. Clements	A. G. Tansley	J. Braun-Blanquet	O. Drude	A. K. Cajander	G. E. Du Rietz 1917—1927
Colony	Society	Society	—	—	Bestand	Bestand(1918) Bodenschichttypus
—	—	—	Part of a Facies	Elementarassociationen mit floristischer Facies	Facies	Association
ubassociation	Consociation	Consociation	—		Association	Association-groups
Association	—	—	Association	Association	Association-classes	
Groups of associations	—	—	(Associations-) Verband	—		
	Association	Association	(Associations-) Ordnung	Hauptassociation (earlier formation)		
(Minor) Formation	Formation (Climax)	—	(Associations-) Klasse	Associationsgruppe		
(Major) Formation	Panclimax	—	—	Vegetationstypus		
—	—	—	—	—	—	Formation
—	—	—	Homologous Formations	Formation (earlier Formationsklasse)	—	Formationgroup
—	—	(Physiographic) Formation	Associationcomplex	Komplex von Elementarassociationen	Siedlungskomplex	Associationcomplex
—	Formation with its seral (ontogenetic) stages	(Climatic) Formation	Klimaxgebiet	Vegetationsregion	Formation	Vegetationregion

The most elementary units in the series of phytocoenoses, or the sociations, have until now been studied nearly only by the Scandinavian School of Ecologists (= Phytosociologists). Until 1928 they were called »associations», but in order to facilitate an international agreement, Scandinavian ecologists have now agreed to accept this term in its Middle-European sense, following Rübel's proposition to apply the new term »sociation» to the earlier Scandinavian »associations» (or »micro-associations»).

Even consociations are rarely recognized in the present ecology of Middle Europe, except in forests, where they are often given the rank of associations, or even a still higher rank. In Clements' system my consociations correspond not only to the »consociations» (with one dominant in the highest layer) but also to the »groupings» (with several dominants in it).

The term association is now used in the same sense — at least theoretically — all over the continent of Europe, and also by many ecologists in America, New Zealand, etc. If Clements and Tansley would sacrifice their use of this term as Scandinavian ecologists have sacrificed theirs, international agreement in the use of this important term could now be easily attained. That the unit recognized as »association» in European ecology is lacking in Clements' system, probably depends only upon the lack of a suitable term. Certainly also Clements must sometimes feel the need of dividing his »Petran montane forest» — or »*Pinus-Pseudotsuga*-association» — into two subordinate units, or one *Pinus ponderosa* - *Pinus flexilis* - association and one *Pseudotsuga* - *Abies concolor* - *Picea pungens* - association, each of them consisting of several consociations.

As to the term federation, it is only an international translation, equally usable in all languages, of Braun-Blanquet's »Verband». As no other term is in use for the unit concerned, there ought to be good hope of getting it generally accepted.

The term subformation is used here for any distinct geographical facies of a formation, analogously with the modern tendencies in the use of the term »subspecies». While my subformations are quite identical with the »associations» of Clements and Tansley, they only rarely coincide with Braun-Blanquet's »Associations-Ordnungen», owing to the rather different principles applied by Braun-Blanquet and myself to the delimitation of the units concerned.

Also my present formations closely correspond to those of Clements, as far as climax units are concerned. Practically all formations recognized by Clements in North American vegetation are accepted also by myself. This use of the term »formation» appears now to be accepted by nearly all extra-European and many European ecologists, and only in this sense there appears to be any hope ot getting it generally accepted.

As to my panformation, it coincides with Clements' »panclimax» (not with his »eoclimax» as erroneously stated in my earlier tables). Certainly Clements will not object to using it as a synonym to that term, as he himself uses »formation» and »climax» alternatively.

The isocoenoses, or physiognomic groups of phytocoenoses, are losing much of their earlier importance in present-day ecology, and certainly they cannot compete for the term »formation» with our formations. Many modern ecologists, like Clements, Tansley, and Pavillard, do not even consider them worth recognizing.

To the phytocoenose-complexes we shall return later on.

As already mentioned, the matter was somewhat simplified in the table by restricting the examples of phytocoenoses to climax units. For seral units it may prove convenient to substitute the terms »sociation», »consociation» etc. with »socies», »consocies» ... etc., following the method proposed by Clements. Owing to the great difficulties in deciding whether a certain phytocoenose should be considered a climax unit or a seral unit, and to the great divergences in the opinion of present ecologists as to this question, I propose to restrict the terms »socies», »consocies» etc. to obviously unstable phytocoenoses (mostly representing products of human influence upon the more stable primeval vegetation).

While the lowest units of phytocoenoses, the sociations, are founded upon a relative homogeneity in all layers, most consociations are homogeneous only in one layer, and the higher units in no layer at all, being founded mainly upon the sociological affinity of the dominants of the layer arbitrarily chosen as base for the classification (mostly the highest one of the layers represented). Thus most phytocoenoses of higher rank than sociations are natural units only in one layer, each of the other layers consisting of alternating synusiae with very little relationship to each other. A good example of this is afforded by the Scandina-

Bottom-layer synusiae												
Bor. *Sphagn.*-form.	Boreal heath-moss form.									Boreal hea		
S. fusc.-feder.	*Hylocomium - Dicranum - Racomitrium* - feder.					*Campt. - Rhytid.* - feder.				*Cladina-Stereocaul*		
S. fusc.-ass.	*D. elong.*-ass.	*Rac.*-ass.	*Bleph. - D. fusc.*-ass.		*Hyl.*-ass.	*Campt. nit.-Sphaeroceph.*-ass.		*Rhytid.*-ass.		*Cetr. isl.-Delis.*-ass.		*St. pasch* ass.
Sphagnum fuscum-consoc.	*Dicranum elongatum*-consoc.	*Racomitrium hypnoides*-consoc.	*Dicranum fuscescens*-consoc.	*Blepharozia ciliaris*-consoc.	*Hylocomium parietinum-proliferum*-consoc.	*Sphaerocephalus turgidus*-consoc.	*Camptothecium nitens*-consoc.	*Rhytidium rugosum*-consoc.	No bottom-layer (»naked»)	*Cetraria Delisei*-consoc.	*Cetraria islandica*-consoc.	*Stereocaulon paschale*-consoc.
									+	+		(+)
		+							+			
						+	+					
									+			
									+			
									+			
		+		+					+	+		
				+	+				+			+
+	+	+	+	+	+	+	+	+	+			+
			+	+	+				+			+
			+	+	+				+	+	+	+
					+	+	+		+			
			+		+				+			+
			+		+				+			+
									+			

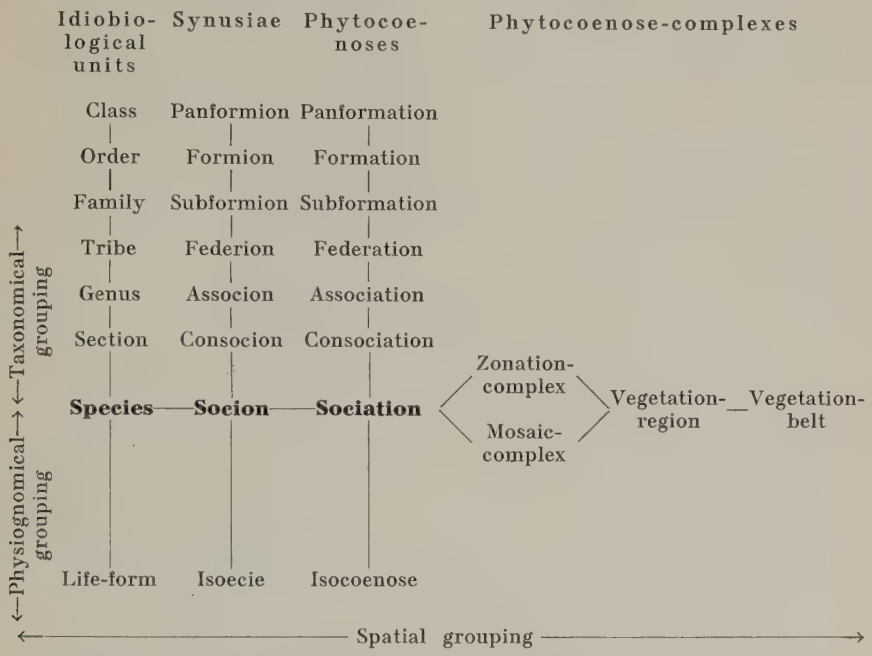
Tab. 2. — Phytocoenoses and synusiae of the alpine ericaceous heath in Scandinavia. (16 dwarf-shrub consocions, combined with 8 lichen-consocions and 9 moss-consocions to 79 sociations known at present.)

				Field-layer synusiae															
				Boreal ericaceous heath form.															
				Loiseleuria - Empetrum - feder.													*V. myrt. - Calluna* - feder.		
				Lois. - Diap. - ass.			*Rhod.*- ass.	*Arct. u. u.*- ass.	*Emp. - Bet. nana - Vacc. ulig.* - ass.							*Cass. tetr.*- ass.	*V.myrt.- Phyll.*- ass.		*Call.*- ass.
				Loiseleuria procumbens - consoc.	*Diapensia - Loiseleuria* - consoc.	*Diapensia lapponica* - consoc.	*Rhododendron lapponicum* - consoc.	*Arctostaphylos uva ursi* - consoc.	*Arctostaphylos alpina* - consoc.	*Vaccinium vitis idaea* - consoc.	*Vaccinium uliginosum* - consoc.	*Empetrum - Vacc. ulig.* - consoc.	*Empetrum nigrum* - consoc.	*Empetrum - Betula nana* - consoc.	*Betula nana* - consoc.	*Cassiope tetragona* - consoc.	*Vaccinium myrtillus* - consoc.	*Phyllodoce coerulea* - consoc.	*Calluna vulgaris* - consoc.
hen form.	*traria - Alectoria* - feder.	*Alect. - Cetr. niv.- Cesiolich.* - ass.	*»Cesiolichen»* - consoc.	+	+	+	+				+								
			Alectoria ochroleuca - consoc.	+				+	+			+	+		+				
			Cetraria nivalis - consoc.	+					+	+	+		+		+				
		Cladina - ass.	*Cladonia alpestris* - consoc.										+	+	+		+		
			Clad. rangiferina-silvatica - consoc.										+	+	+		+		

vian facies of the arctic subformation of the boreal ericaceous heath formation, containing 79 sociations known at present (Tab. 2). If only the field-layer is taken into consideration, these sociations may be naturally grouped into 16 consociations, forming 7 associations and 2 federations. But as even these consociations consist of sociations with the most different bottom-layers, some authors have preferred to found the phytocoenoses superior to the sociations not upon the field-layer but upon the bottom-layer. In this way we get 18 consociations with a homogeneous bottom-layer but a very variable field-layer, as is shown by the table. And these bottom-layer consociations may be grouped to 11 associations, 4 federations, and 3 formations, all of them with a very variable field-layer. It is impossible to say that the consociations, associations, etc. founded upon the field-layer are more natural than those founded upon the bottom-layer, or vice versa. — The same conflict between the layers is met with in most other formations, as the grouping of the sociations to phytocoenoses of higher rank mostly includes an obvious violence done to the natural units of the layers not chosen as base for the classification. The only way out of this conflict appears to be that proposed by Gams in 1918, *i. e.* the method of dividing each sociation into its elementary one-layered units, or s y n u s i a e, and grouping the synusiae of each layer independently of those of the other layers to s y n u s i a e of higher rank. The practical application of this method is also seen in the table. It includes the establishment of a whole series of higher units of synusiae corresponding to that of the phytocoenoses. The sociations are thus dissolved into their elementary s o c i o n s, and the socions of each layer are grouped independently of each other into c o n s o c i o n s, a s s o c i o n s, f e d e r i o n s, and f o r m i o n s, as shown in the table. In Tab. 3 these higher units of synusiae are parallelized with the corresponding phytocoenoses and with the units of idiobiological taxonomy. — If this synusiological method is generally applied, the p h y t o c o e n o s e s superior to sociations lose, of course, much of their importance for the classification of vegetation.

P h y t o c o e n o s e - c o m p l e x e s are vegetational units consisting of phytocoenoses with little or no relationship to each other but more or less regularly alternating. They are of several kinds. Good examples for m o s a i c - c o m p l e x e s are furnished by the »association-complexes» described by Osvald and myself from

Tab. 3. — System of plant-sociological units and their analogies with the units of idiobiology.



Scandinavian bogs, maritime rocks etc. Zonation-complexes are found on the shore of every lake or river, and have been described by many authors. Phytocoenose-complexes of greater extension and mostly of less regularity are the vegetation-regions, in most cases practically identical with CLEMENTS'» climaxes» or »formations» (if the seral stages of CLEMENTS' are included) and with the »Klimaxgebiete» of BRAUN-BLANQUET. Contrary to the monoclimax-theory developed by CLEMENTS' and BRAUN-BLANQUET, I find it necessary, however, to maintain the polyclimax-theory developed by DOMIN, GAMS, GLEASON, NICHOLS, NORDHAGEN, SCHARFETTER, TANSLEY, myself, etc. (comp. DU RIETZ, Vegetationsforschung p. 346), *i. e.* to admit that several climax-phytocoenoses — in many cases with very little relationship to each other — may occur side by side in the same vegetation-region, but in edaphically different habitats (»edaphic climaxes» of NICHOLS, TANSLEY, etc.). My own field-experience certainly does not support the theory of the power of a uniform climate to transform all these edaphically different habitats into

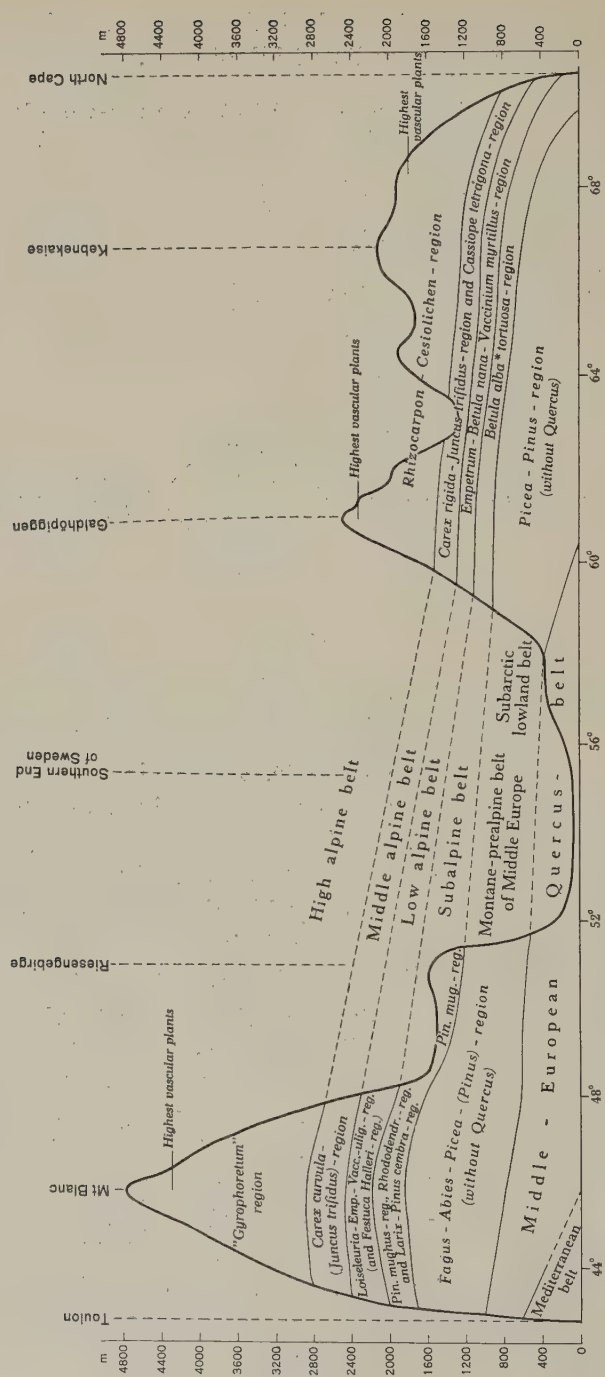


Fig. 1. The vegetation-belts of Central and Northern Europe along a belt-transect from the Alps to the northern end of Scandinavia.

one comparatively uniform »climax-habitat» (»climax-soil» etc.), as postulated by the monoclimax-theory.

Vegetation-regions homologous in their altitudinal position constitute together one v e g e t a t i o n - b e l t (Vegetationsstufe, étage de vegetation). More local altitudinal divisions within a vegatation-belt are called v e g e t a t i o n - h o r i z o n s.

The practical application of the concepts »vegetation-region» and »vegetation-belt» is demonstrated in Fig. 1, showing the vegetation-belts and the main vegetation-regions of Middle Europe and Scandinavia along a belt-transect from the Alps to the Arctic Sea.[1] The contour-line of the profile is drawn after the highest elevations within the belt concerned. In many of the regions concerned several local horizons may be developed. Most of those regions would certainly coincide with the »climaxes» of Clements and the »Klimaxgebiete» of Braun-Blanquet. Nevertheless, according to my opinion, each of them contains not one but many climax-phytocoenoses, even of highest rank. In the names of the vegetation-regions only some of the dominating climax-phytocoenoses, or »regionale Hauptphytocoenosen», have been included. But in the *Quercus*-region of South Sweden, for instance, certainly both *Quercus*-forests and *Picea-Pinus*-forests, among others, must be admitted as climax-phytocoenoses, the former on better and the latter on poorer soils. In the case of the alpine vegetation-regions of the Alps and of Scandinavia, there is a complete agreement among Scandinavian ecologists that the dominating dwarf-shrub-heath and grass-heath of the acid and moderately snow-covered ground in the low-alpine and middle-alpine belts respectively, are by no means the only climax-phytocoenoses of these regions as assumed by Braun-Blanquet. Parallel with them there also occur not only subneutrophilous (pH 5,5—7) and neutrophilous climax-phytocoenoses (the latter only in the Alps) of *Dryas*-heath, *Elyna*-heath, various meadows etc., but also other acidophilous climax-phytocoenoses both chionophobous (on wind-exposed ridges) and chionophilous (or snow-loving, *i. e.* »Schneeboden» communities), consisting of grass-, herb-, dwarf-*Salix*-, moss-, and lichen-communities very different from the dominating subchionophobous heath. Usually, since the same main ve-

[1] For further details comp. Du Rietz, Vegetationsforschung auf soziationsanalytischer Grundlage (Abderhalden's Handbuch der biologischen Arbeitsmethoden, Abt. XI, Teil 5, 1930), p. 353—358.

getation-regions are admitted by monoclimaxists and polyclimaxists, this theoretical divergence appears to be of rather small practical importance.

For the comparison of the vegetation-belts in different parts of the world it is most important to use the terms »alpine», »subalpine» etc. only for really homologous belts in different mountain-districts. In present literature chaos prevails also in this respect, especially in the use of the term »subalpine belt». In Middle-European literature, much of the prealpine forest-belt of the profile is often called »subalpine belt». Also most of the »subal-

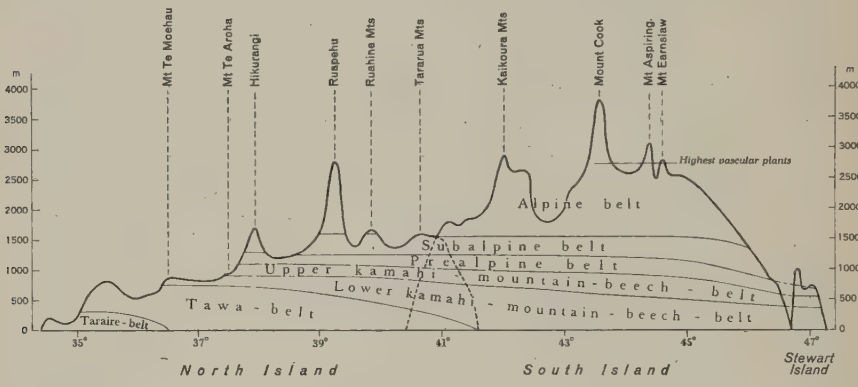


Fig. 2. The vegetation-belts of New Zealand.

pine belt» of North American ecologists I would rather call prealpine, as the so-called »subalpine» *Picea* - *Abies* - forest of North America is clearly homologous to the prealpine forest-belt of Europe. The real subalpine belt of North American mountains appears to be formed by *Alnus* - scrub in Alaska, by *Pinus aristata* - Krummholz in Colorado, and possibly by a *Larix Lyallii* - *Pinus albicaulis* - region in the northern Rocky Mountains, analogous to the subalpine *Larix* - *Pinus cembra* - region of Middle Europe.

Another example of vegetation-belts is given in Fig. 2, showing an analogous sketch-profile of the vegetation-belts of New Zealand (founded upon a synthesis of my own observations during half a year of field-work in 1926—1927 with the literature concerned, especially with the fundamental works of L. Cockayne). Owing to the sloping of most of the belts from north to south, no belt can be called montane over the whole country (just as in Europe),

Tab. 4. — The vegetation-regions of New Zealand.

		Mixed forest facies (maritime)	Beech-forest facies (maritime—subcontinental)	Grassland facies (continental)
Alpine belt		*Danthonia crassiuscula* (short grass) - region (up to about 2 000 m), etc.		
Subalpine belt		*Danthonia Raoulii* (tall tussock) - subalpine scrub - region		
Mountain-beech belt	Prealpine belt	*Libocedrus Bidwillii* - *Dacrydium biforme* - region	Prealpine mountain-beech region (Prealp. *Nothofagus cliffortioides-Menziesii*-reg.)	*Festuca novæ-zelandiæ* - *Poa cæspitosa* - region
	Upper kamahi - mountain-beech - belt	Kaikawaka-kamahi-region (*Libocedrus Bidwillii* - *Weinmannia racemosa* - reg.)	Middle mountain-beech region (Middle *Nothofagus cliffortioides-Menziesii*-reg.)	
	Lower kamahi - mountain-beech - belt	Rimu-kamahi-region (*Dacrydium cupressinum* - *Weinmannia racemosa* - reg.)	Lower mountain-beech region (Lower *Nothofagus cliffortioides-Menziesii*-reg.)	
Beilschmiedia-belt	Tawa-belt	(*Beilschmiedia*) *tawa* - region		
	Taraire-belt	(*Beilschmiedia*) *taraire* - region		

while no such difficulties are met with in the prealpine, subalpine, and alpine belts. In Tab. 4 the division of those vegetation-belts into vegetation-regions is shown. Most of these vegetation-regions would certainly be accepted by CLEMENTS as good »climaxes» and by BRAUN-BLANQUET as good »Klimaxgebiete» — though in some cases two or three of my regions would rather form one »climax» together (*e. g.*, the three mountain-beech regions, which, however, are entirely different in the composition of the lower layers). Also in those vegetation-regions, however, it is evident that many of them contain not one, but several climax-phytocoenoses even of highest rank. In the *Beilschmiedia tawa* - region, for instance, the dominating climax-phytocoenose of the richer and moister soils is a mixed rain-forest with *Beilschmiedia tawa* as the main dominant and a lighter upper tree-layer of *Podocarpus, Dacrydium*, or *Metrosideros robusta*, while the dominating climax-phytocoenose of the dryer and poorer soils is an entirely different *Nothofagus Solandri-truncata* - forest. And in the subalpine belt both the *Danthonia Raoulii* - tussock and the subalpine scrub must certainly be recognized as climax-phytocoenoses, as well as the various dwarf-shrub heath phytocoenoses of wind-exposed ridges etc. In the alpine belt there is — just as in Europe — a whole series of very different climax-phytocoenoses from the extremely chionophobous cushion-plant communities on wind-exposed ridges to the various extremely chionophilous »Schneeboden»-communities (the *Danthonia crassiuscula* - consociation belongs to the intermediate group). — But also in this case the attitude taken by the investigator towards the monoclimax- and polyclimax-theories, probably is of very little practical importance for the actual delimitation of the vegetation-regions.

It appears to me that we have now reached such a general agreement regarding the delimitation of vegetational units of various kinds, that we should not allow this enjoyable fact to be obscured by divergences in the theoretical interpretation of the structure and future of those units — monoclimax- and polyclimax-theories — nor by divergences of purely terminological character. Especially the divergences last mentioned should certainly not be allowed any longer to hamper international collaboration in ecology. I firmly believe that the time is ripe now to take up the idea again of formally regulating this terminology by international agreement. And I herewith propose that an international com-

mittee should be appointed to investigate the possibility of attaining general agreement at least in some of the more important concepts and terms in Plant Sociology, and if sufficient agreement can be attained, should make proposals for an international terminology to be presented to the next international botanical congress.[1]

Plant-biological Institution of Upsala University, August, 1930.

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[1] This proposition was accepted by the Congress, and the author was appointed to act as a recorder in the committee elected by the Congress. The author will be very indebted to his colleagues in and outside this committee for any constructive criticism of the proposals made in this paper and in ABDERHALDEN'S Handbuch (comp. above p. 499). Such criticism will be of great value for the organization of the work of the committee.

Svensk Botanisk Tidskrift. 1930. Bd. 24, H. 4.

ON DOMATIA IN THE GENUS NOTHOFAGUS.

BY

G. EINAR DU RIETZ.

A remarkable feature of many trees and shrubs, noted already by early botanists, is the occurrence of hair-tufts and various types of hollows with or without hairs in the vein axils of the under-surface of the leaves. These structures were brought into the centre of the botanical discussion through a paper by A. Lundström (1887), in which they were carefully described and pictured from a great number of species, and in which a darwinistic theory was invented for their »explanation». While earlier authors had described them rather vaguely as »scrobiculae», »glands» etc. (comp. Hamilton 1896 pp. 758—759), Lundström invented the new term »domatia» (from δωμάτιον, small house) for their designation. According to Lundström all such structures ought to be explained as adaptations to a mutualistic symbiosis with the Acarides often found inhabiting the hair-tufts and hollows. While the plant offered the Acarides a suitable shelter, the Acarides were supposed to be beneficial to the plant by keeping the leaves clean from spores and mycelia of parasitic fungi, and perhaps also in some other ways. The term »domatia» was introduced by Lundström to designate not only the structures mentioned above, but »alle solche Umbildungen eines Pflanzentheils, die mit einer mutualistischen Symbiose in directer Verbindung stehen. Sie werden von Symbionten bewohnt, welche sowohl dem Thierreiche wie dem Pflanzenreiche angehören können. Sie sind also entweder Zoodomatien oder Phytodomatien. Beispiele von den erstgenannten sind die Myrmicodomatien und die in dieser Arbeit behandelten Acarodomatien. Als ein Beispiel von Phyto-

domatien betrachte ich die Wurzelknollen der Leguminosen (M y c o d o m a t i e n) und ich werde bei einer anderen Gelegenheit die Gründe dieser Annahme anführen; ein zweites Beispiel wird von den Höhlungen in den Azollablättern geliefert (P h y c o d o m a t i e n)» (Lundström 1887 p. 71). As to the origin of the domatia, Lundström thought that they were originally produced by the Acarides etc., but later had become stabilized and hereditary.

Fig. 1. *Nothofagus Menziesii* (Hook. f.) Oerst. from Governor's Bush, Hooker Valley, South Island, New Zealand, 14. 3. 1927, G. Einar and Greta Du Rietz nr. 2134 a. — *a*. Under-surface of adult leaf, × 2. — *b*. Detail of the same leaf showing two domatia, × 8. — Greta Du Rietz delin.

Lundström's theory was a typical product of its time, and was rather favourably accepted by contemporary authors. Grave doubts, however, were expressed by A. G. Hamilton (1896), who had investigated the domatia in a great number of Australian plants and found »that the whole question needs much further observation and research». I have only seen very few references to the matter in more recent literature, but probably only few botanists of our days are likely to believe in Lundström's theory of the mutualistic

symbiosis. His term »domatia», however, has become firmly established, though hardly in the wide sense used by Lundström. By most authors of the present day it is probably used simply as a morphological designation for the »acarodomatia» of Lundström, *i. e.* for the various types of hollows, hair-tufts etc. on the under-surface of the leaves. In this sense it will also be used in the following contribution.

Among the many genera of domatia-producing trees and shrubs enumerated by Lundström (1887), Lagerheim (1890, 1892), Hamilton (1896), Malme (1900), and other authors, the genus *Nothofagus* is not represented. It was, therefore, with some surprise that I found that two of the common New Zealand species of this genus, *N. fusca* (Hook. f.) Oerst. and *N. Menziesii* (Hook. f.) Oerst., regularly carried well developed domatia, apparently overlooked by most of the authors dealing with the species concerned. The only exception appears to be formed by L. Cockayne, who, with his well-known accuracy, mentions the occurrence of »fringed domatia» (1921 p. 181, 1928 p. 235) or »tiny fringed pits at the junction of the lower veins and midrib» (1926 p. 20) on the under-surface of the leaves of *N. Menziesii*. To the occurrence of domatia in *N. fusca* I have found no reference at all. As the

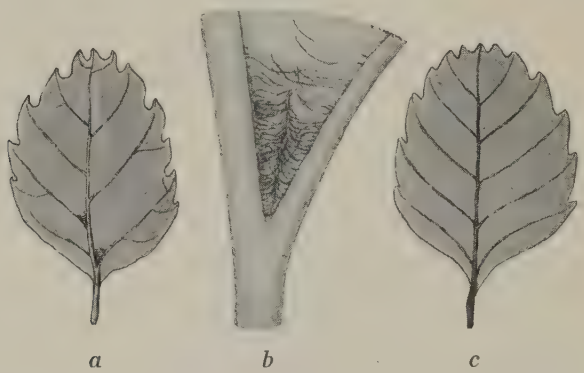

Fig. 2. *a, b. Nothofagus fusca* (Hook. f.) Oerst. from Kinloch, western end of Lake Wakatipu, South Island, New Zealand, 22. 2. 1927, G. Einar and Greta Du Rietz nr. 1967. — *a.* Under-surface of adult leaf in nat. size. — *b.* Detail of the same leaf showing the domatium in the lowest vein axil, × 8. — *c. Nothofagus truncata* (Col.) Ckn. from York Bay near Wellington, North Island, New Zealand, 7. 12. 1926, G. Einar and Greta Du Rietz nr. 1021. Under-surface of an adult leaf in nat. size. — Greta Du Rietz delin.

occurrence of domatia in these two species appears to have some bearing upon the general problems connected with the domatia, a more detailed account of the matter may perhaps be of some value.

Though I have investigated the leaves of all the species of *Nothofagus* (using my own collections of the five New Zealand species and of the two Australian species *N. Moorei* (F. v. M.) Krasser and

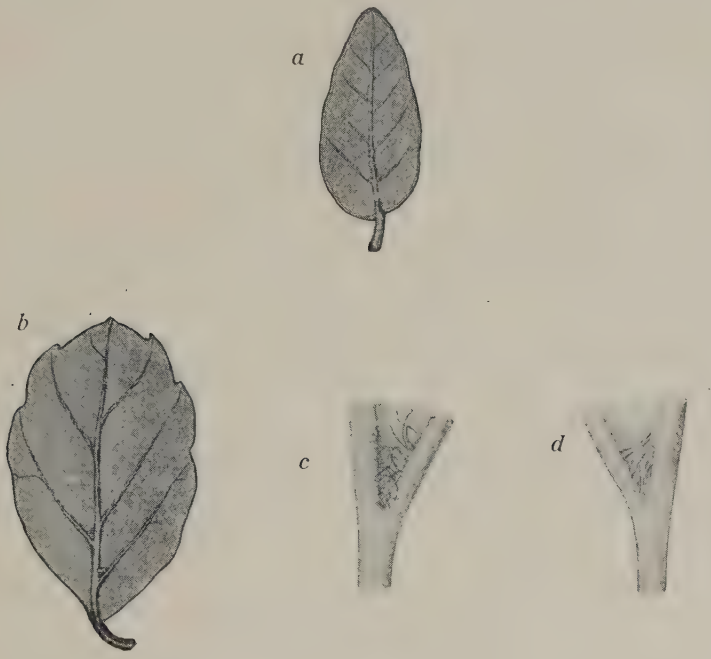

Fig. 3. *a. Nothofagus cliffortioides* (Hook. f.) Oerst. from the lower Routeburn Valley, South Island, New Zealand, 22. 2. 1927, G. Einar and Greta Du Rietz nr. 1939. Under-surface of adult leaf, × 2. — *b—d. Nothofagus cliffortioides* (Hook. f.) Oerst. × *fusca* (Hook. f.) Oerst. from Kinloch, western end of Lake Wakatipu, South Island, New Zealand, 22. 2. 1927, G. Einar and Greta Du Rietz nr. 1966. — *b.* Under-surface of adult leaf of a form approaching *N. fusca,* × 2. — *c.* Detail of the same leaf showing the domatium in the lowest vein axil, × 8. — *d.* The domatium in the lowest vein axil of an adult leaf of a more intermediate form, × 8. — Greta Du Rietz delin.

N. Cunninghamii (Hook.) Oerst., and the material of the Botanical Museums of Stockholm and Lund for the rest of the species), I have found domatia only in the two New Zealand species mentioned above. In *N. Menziesii,* domatia are always found in the lower vein axils of the under-surface of the leaves (fig. 1 *a*), mostly 2

or 3 in each leaf. They belong to Lundström's (1887 p. 53) type 3 (= Hamilton's type 1), or to the »pit-formed domatia» of Malme (1900 p. 5), and are densely fringed by brownish yellow hairs (fig. 1 *b*). They are so deep that a distinct knob is seen on the upper-surface of the leaf opposite to each domatium. Also in *N. fusca* every adult leaf (in the juvenile leaves the domatia appear to be often lacking) carries domatia in the lower vein axils of the under-surface (1, 2, or 3 domatia in each leaf), but these domatia are of a type rather different from that of *N. Menziesii*. They belong to Lundström's type 1 (= Hamilton's type 4), or to Malme's (1900 p. 5) »hair-tuft domatia», *i. e.* they are not pits but simply more or less dense tufts of brownish yellow hairs in the unmodified vein axils (fig. 2 *a*, *b*).

It is an interesting fact that domatia are always lacking in *Nothofagus truncata* (Col.) Ckn. (fig. 2 *c*), a species very nearly related to *N. fusca* and until the last decade mostly confused with it (comp. Cockayne 1926). The occurrence or non-occurrence of domatia thus forms a most important difference between these two species.

It was pointed out already by Lundström that domatia are hardly ever found in tomentose leaves. This holds true also in *Nothofagus*, since domatia are lacking in the two species with a tomentose under-surface of the leaves, *i. e.* in *N. Solandri* (Hook. f.) Oerst. and *N. cliffortioides* (Hook. f.) Oerst. (comp. fig. 3 *a*). In the highly polymorphic hybrid between *N. cliffortioides* and *N. fusca* (comp. Cockayne and Atkinson 1926, Cockayne 1926 and 1929, Cockayne and Phillips Turner 1928, Du Rietz 1930 *a* p. 370), both forms with and forms without domatia are found; in the forms with tomentose leaves the domatia are always lacking. Fig. 3 *b*, *c* show a form approaching *N. fusca*, with rather well developed domatia, while fig. 3 *d* shows a more intermediate form with very much reduced domatia.

Though a rather large herbarium-material of *N. fusca* and *N. Menziesii* was searched for Acarides, such were found only in one domatium of *N. fusca* and in none of *N. Menziesii*. The theory of Lundström thus appears hardly to be applicable in the case of *Nothofagus*.

While the domatia-lacking species *N. truncata* and *N. Solandri* are restricted to the lower parts of North Island and northernmost South Island, *i. e.* mainly to the *Beilschmiedia tawa* - belt (comp. Du

Rietz 1930 *b*), both the domatia-producing species (*N. fusca* and *N. Menziesii*), together with the domatia-lacking species *N. cliffortioides,* belong to the somewhat cooler »mountain beech belt» occupying the higher altitudes of the forest-clad part of North Island and ranging in the greater part of South Island from sea-level to timber-line (comp. Du Rietz *l. c.*). However, I do not believe that this distribution can be taken as a proof of any causal relation between the climate and the formation of domatia. I am far more inclined to take the occurrence of domatia in *N. fusca* and *N. Menziesii* as a sign of taxonomic relationship between these two species, and to regard the occurrence or non-occurrence of domatia as a question of accidental distribution of certain genes in the syngameon probably formed by the genus concerned before the differentiation of the present species (comp. Du Rietz 1930 *a* pp. 411—412). The restriction of the domatia-producing species of *Nothofagus* to a certain belt in the vegetation of New Zealand would then form only another example of the only historically explicable restriction of a certain character to a geographically limited but taxonomically highly polymorphic part of a genus-population, *i. e.* to several species widely differing in other respects but inhabiting the same area (Du Rietz 1930 *a* pp. 411—412).

Plant-biological Institution of Upsala University, September 11th, 1930.

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GENECOLOGICAL UNITS AND THEIR CLASSIFICATORY VALUE.[1]

BY

GÖTE TURESSON.

The progress recently made in genetics, cytology and ecology has added much to our knowledge of the intrinsic nature of the individual organism, as well as of the composition of the organism-groups which we use to call species. The results obtained in these fields have not only renewed the interest among systematists for theoretical discussions on the species question and related problems; they have also opened the way to the experimental study of those problems. Systematics of the purely descriptive kind do not provide the instrument by which the cause and nature of group-phenomena in organisms may be investigated, nor do systematics of this kind furnish the adequate means of determining the natural boundaries of the groups. While it is true that classification might be made without any such means it is equally true that a classification of this kind must be considered as a mere preliminary and be of limited scientific value. In order to build up a satisfactory system of units and relationships within even small groups of plants or of animals, it is necessary that variation and hybridization, instead of being conjectured, should be put to an experimental test. That this procedure is something quite different from the mere cataloguing of a flora is evident,

[1] Presented to the Fifth International Botanical Congress at Cambridge and read in the joint discussion on »Geographical distribution and its relation to the concept of species» on August 20, 1930.

and its appeal to the advocators of so-called practical taxonomy is therefore anything but strong. When we nevertheless are entitled to speak to day of the experimental basis of classification, and attempt to demonstrate its merits, a considerable quantity of facts from different fields of inquiry and from a number of experimenters lie open to us.

By whatever standard we determine the limits of our units or groups I suppose we all agree that these units comprise a greater or lesser number of biotypes. In normal sexual plants the biotypes within such a unit are able to interbreed, although in some plants where apomixis prevails they are unable to do so. We may call these different kinds of biotypes amphimicts and apomicts respectively, as I proposed some years ago (Turesson 1926). The sexual biotypes claim greater attention for the moment. Given the possibility to interbreed — which is best attained in garden experiments — biotypes belonging to one group may sometimes produce fertile offspring when crossed with biotypes differing widely in external morphology. Several such extreme crosses have been made and the progeny studied. I may mention the *Salix caprea* × *viminalis* cross studied by Heribert-Nilsson (1918), *Geum rivale* × *urbanum* by Winge (1928), *Medicago falcata* × *sativa*, and many others. The great fertility of the offspring of these crosses, and the relatively frequent occurrence of such hybrids in nature undoubtedly indicate a rather close relation, i. e. genotypical similarity, between the biotypes involved in the crosses. Of a phylogenetical relationship, which is altogether a question apart (cf. Kristofferson 1926), we know nothing in these cases, and very little indeed in any others. Now while the genotypical relationship between the components in the crosses mentioned must be regarded as rather close, the morphological relationship between them is so slight that they have come to represent time-honoured species. Conversely, hybridization experiments with biotypes presenting very close morphological relationship sometimes give negative results. For illustration I may refer to the studies made on *Erophila verna* by Rosen (1925) and by Winge (1926), on *Capsella bursa pastoris* by Shull (1923), and the *Galeopsis Tetrahit*-group by Müntzing (1930). We cannot, however, conclude that the biotypes within these groups, on account of their failure to interbreed, are genetically unrelated. The negative result of such crosses may in some cases

be due to differences in chromosome number, as in *Erophila* and *Capsella*, sometimes to the failure of the pollen grains to grow on the foreign stigma, or the hybrid seeds may be defective (cf. Müntzing 1930). The reason, however, why intersterile biotypes of the kind just mentioned are grouped in one and the same systematic unit is the similarity between these biotypes in external morphology. The morphological criterion leads thus in this case to association of intersterile biotypes, while in the case of the first mentioned, easily intercrossing species, it led to separation.

We have spoken of relationship, of morphological, genotypical and phylogenetical relationships. If we now turn to the pertinent question of the kind of units needed in classification, we are at once faced with the task of specifying the purpose and the object of our units. Apart from demands of practicability most systematists aim at a phylogenetical foundation of their units, though in practice, as we all know, very little notice is taken of this proposition. Since morphological relationship is often a very poor indicator of phylogenetical relationship, and since the genetical and cytological methods at present also largely fail to throw light on questions of phylogeny, we certainly feel at a loss as to the phylogenetical grouping of the biotypes. Obviously, it is the effort to arrive at e v o l u t i o n a r y units which makes the systematist insist upon the phylogenetical foundation of his units. Without minimizing the theoretical importance of such purposes I should like to maintain, first, that natural definiteness of biotype-groups does not necessarily involve common descent, and, secondly, that a classification of biotypes in definite and natural groups is attainable without resort to phylogenetical speculations. The guiding principles of this classification are based on genetical and ecological inquiry, and the units founded might therefore be called g e n e c o l o g i c a l units.

We have already seen that under certain circumstances biotypes belonging to different, so-called good species may intercross and give rise to a multitude of more or less fertile intermediates. The experimenter is able to extend at will the boundaries of those biotype-compounds which are the result of intercrossing, for instance between *Salix caprea* and *S. viminales, Geum rivale* and *G. urbanum*, *Medicago falcata* and *M. sativa*, and scores of others. In his garden the geneticist does not find t w o compounds from such a cross but o n e, and from a purely genetical point of view

there is certainly no reason for sorting the parent types into two separate units. Why then, if intermediates are so readily formed, is this genetically so harmonious biotype-compound found in nature to be split into two groups? The two often meet in nature but, admitting the occurrence of hybrids, why does not an intermediate population establish itself? Obviously it must be a reduced and insufficient viability on the part of the intermediates that keeps the groups separated in nature. We have much evidence on this point, and I need only refer to the work of Heribert-Nilsson (1918) on the offspring of the cross *Salix caprea* × *viminalis* to recall all the different kinds of disturbances which mark the descendants of such crosses. In crosses within certain biotype-compounds and especially in those where different chromosome numbers are found, the cause of the reduced viability of the offspring may be confidently looked for in defective chromosome- and gene-affinity. Such cases have been carefully worked out for instance by Clausen (1926) in the *Viola tricolor*-group, and by Müntzing (1930) in the *Galeopsis Tetrahit*-group. Still, the very great number of different biotypes within these and similar compounds enables us, no doubt, experimentally to bridge the gaps between the different sterility groups. However that may be, the effect of the factors controlling viability and fertility in such biotype-compounds in nature, is most remarkable. The population becomes split into two or more intraviable and intrafertile groups. These groups obviously remain constant as long as fertility and viability are greater between the biotypes within the same group than between the biotypes of different groups.

As appropriate names denoting the two genecological units now under discussion I have proposed the terms c o e n o s p e c i e s (the larger unit) and e c o s p e c i e s (the smaller units; Turesson 1922, 1929). Thus, expressed in the terms of genecology, *Geum rivale-urbanum* forms a coenospecies, which is made up of the two ecospecies *Geum rivale* and *Geum urbanum*. Similarly, as Müntzing found recently, the *Galeopsis Tetrahit*-group constitutes one coenospecies formed by two component and coordinate ecospecies. The Linnean species *Viola tricolor*, again, is a coenospecies, which is made up of at least three ecospecies, namely *Viola tricolor*, in the strict sense, *V. arvensis*, and *V. alpestris*.

In biotype-populations where sexual reproduction is replaced by apomixis, the situation is quite different. On account of apo-

mixis the biotypes, or the apomicts as they may be called, within such populations are unable to interbreed. Extensive biotype-compounds are sometimes exclusively built up by apomicts, as we know from the Linnean species *Alchemilla vulgaris* and *Antennaria alpina*. Obviously such compounds represent units of a distinct kind and are altogether different from the ones previously discussed. I have suggested the term agamospecies to cover units of this nature (Turesson 1929).

Summarising the matter already presented it must be perfectly clear to all that the species-units of traditional taxonomy, not least those of Linnean rank, represent compounds of very different order and magnitude. The Linnean species sometimes matches the coenospecies, in other cases it corresponds to the ecospecies, in still others to the agamospecies. It need scarcely be remarked that, in face of such facts, the attempt to formulate one standard definition of the »species» is made in vain.

The ecospecies attracts the greater interest from a genecological point of view, and its behaviour throws much light on the origin of subspecific units. Whether of limited or extended geographical distribution the ecospecies still consists of a greater or lesser number of biotypes. Now, if for the sake of argument we assume that a number of different biotypes were growing and multiplying competition-free on a piece of land under quite uniform conditions and with all possibilities of interbreeding, then only one kind of subspecific units would be found, the biotypes themselves, and the number of distinguishable units or biotypes, apart from the number of combining genes, would depend only on the particular mode of reproduction and fertilization of that ecospecies. Obviously, in the case of an obligate cross-breeder, lacking the power of vegetative propagation, we would have just about as many units as individuals. In nature, however, conditions are not uniform, and barriers to free intermixture are always present, splitting up the biotype-body into smaller groups each containing a diverse number of biotypes. Of even greater importance than barriers of merely topographic nature are climatic barriers, and these are therefore of prime importance for the origin and maintenance of the group-isolations of biotypes found within the ecospecies.

In order fully to appreciate the group-isolating effect of climate we have to consider the great hereditary variation between diffe-

rent biotypes of an ecospecies, not only in regard to morphological details but, still more important, to physiological behaviour. A critical study by means of garden experiment discloses the fact that biotypes coming from different climatic regions within the distribution-area of an ecospecies always differ from one another in characteristics of vital importance for the life of the plant in just those regions. Great differences are thus seen in earliness, hardiness, moisture requirements, resistance to parasites, and so on. Corresponding to the change of climate there is a change in the biotype-characteristics of the ecospecies, and this change can only be explained by the selective influences of the environmental factors on the biotype-composition of the ecospecies in different climatic regions. Thus, owing to differences in climate the biotype-compound of the ecospecies is split into smaller groups each specialized for a special type of climate, and these groups remain isolated, since the non-specialized biotypes occasionally appearing in the respective groups are steadily eliminated. An intermediate biotype-population is often found in regions where the transition-area between two extreme types of climate attains a certain extent. Similarly in places where the climate is edaphically diversified several distinct habitat-groups may be found, each marked off by definite and hereditary biotype-characteristics. These climatic and edaphic units, arising and maintained by the sorting and controlling effect of climate and habitat-factors upon the biotype-compound of the ecospecies, are the e c o t y p e s (Turesson 1922, 1925, 1930). All the ecospecies tested in my experimental garden have been found to fall into ecotypes, and our knowledge of ecotypical differentiation is rapidly growing from additional work by other contributors on plant species (cf. for instance Tedin 1925, Gregor and Sansome 1927, 1930, Gregor 1930, Sinskaja 1928, Stapledon 1928), as well as on animal species (cf. Dobzhansky 1927, Rumjancew 1928).

Units of unmistakable ecotypic nature have frequently been described by systematists as »forms», »varieties», »subspecies», and as »species», and sometimes even one and the same ecotype has been described alternately as »form» and »species». Certainly, for pure registration purposes it matters little, but for genecological ends the proper valuation of the ecotypes is naturally of great importance. It need scarcely be remarked that m o r p h o l o g i c a l methods alone are altogether insufficient for the classification of

an ecospecies-population into ecotypes. Apart from our inability from morphological studies to distinguish between hereditary variations and modifications there are, as is well known, species which display very little morphological variation among their biotypes. Upon closer study in garden experiments, however, well marked ecotypes even in such biotype-compounds are easily unveiled. Now these ecotypes remain concealed for ever from the ordinary taxonomist, in spite of the fact that their recognition is of the utmost importance for the understanding of the geographical distribution of the particular species. On the other hand, species-units displaying great morphological variation among their component biotypes are eagerly studied and become loaded with subunits of very dubious value to the ecologist and plant-geographer. The attempt to group the biotypes into subspecific units according to phylogenetical relationship also largely fails, since at present questions of phylogeny between subspecific units are as much beyond the reach of experimental attack as they are in the case of specific units. The analysis of genetical relationship, indispensable in recognizing specific units, obviously offers the only means of distinguishing between hereditary variations and environmental modifications and is therefore equally necessary in the study of subspecific units. However, the genetical analysis brings us down to the ultimate units, i. e. the biotypes, but it does not help us to recognize the grouping of biotypes as found in nature. The ecological relationship between the biotypes is certainly the deciding factor here, and the ecotypes therefore fulfil the requisites of subspecific units originating through nature's own grouping of the biotypes.

Landskrona, May 12th., 1930.

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PINUS AND BOLETUS IN THE TROPICS.

BY

BJÖRN PALM.

Our knowledge concerning the mykorrhiza of coniferous trees has recently taken a long step forward especially thru the intensive work of Melin. As a result it is definitely known that *Boletus* species customarily function as nutrient purveyors in the mykorrhiza of a number of European Gymnosperms. Apparently, however, data on the occurrence of *Boletus* species in association with tropical conifers particularly the genus *Pinus* are wholly lacking. During my journies in the tropics of the old as well as the new world, several opportunities arose to make empirical observations on the intimate associations of *Boletus* species with a couple of tropical pines.

Pinus Merkusii is the only one of these native to the Dutch East Indies and occurs there especially on the island Sumatra. On the northern part of the island in particular, at and above an elevation of 600 m. above sea level *P. Merkusii* commonly forms forests. These forests attain their best form in the interior of Atjeh in the Takengon district. Fig. 1 shows a rather pure stand on this tract at an elevation of 1200 m. *Pteris aquilina* enters rather prominently into the ground vegetation and grows to a height of 1,5 m. In open stands high grasses and species of *Scitamineae* form the most prominent components of the vegetation. Where the pines are dense the ground vegetation is sparse and the needle litter becomes deep and compact. In such places one not infrequently finds a *Boletus* which according to a preliminary determination of the Mycological Herbarium in Buitenzorg (Java) is probably identical with *Boletus pallidus*. It is hardly necessary to emphasize that

I have not observed this *Boletus* beyond the rather distinct borders of the pine forests in the Takengon district.

My attention was further attracted to a possible association of *Pinus Merkusii* and *Boletus pallidus* in these forests by observing some *Boletus* specimens seemingly growing direct on pine roots which had been washed out of sandy soil on steep slopes by torrential rains. Deep gullies were thus often washed out of the

Fig. 1. *Pinus Merkusii* forest in the Takengon district in Northern Sumatra at an elevation of 1200 m.

hillsides leaving the roots on the surface in an easily observable condition. That *Pinus Merkusii* actually is a mykorrhiza former was determined on material which I took home and examined by the usual cytological method.

These observations were later unexpectedly corroborated thru an experience in another part of Sumatra.

On the east coast of the island at an elevation of 600 m. is situated a little botanical garden, Siboelangit, a branch of the renowned Buitenzorg Gardens of Java. Here many plants native

to Sumatra have been planted. Among these are a number of *Pinus Merkusii* which do not occur naturally closer than about 250 kilometers air line from the garden. The trees had originally

Fig. 2. Young *Pinus Merkusii* associated with *Boletus pallidus* (?) in Brastagi, Central Sumatra, at an elevation of 1400 m.

been brought as young plants from Takengon in Atjeh, the region already mentioned. At the time of my observations (1925) they were about 10 years old. Under these pines I observed the same *Boletus* in different stages of development which I had seen in

Takengon. In other parts of the Siboelangit Garden I could find no *Boletus*.

A further *Boletus* observation, outside of the tree's natural range deserves special mention in this connection.

In a little village called Brastagi situated on a high plateau (about 1 400 m. elevation) in the central portion of Sumatra numerous individuals of *Pinus Merkusii* obtained at Takengon had been

Fig. 3. *Boletus pallidus* (?) in situ under *Pinus Merkusii*. Brastagi in Central Sumatra at an elevation of 1400 m. — $^2/_3$ nat. size.

planted during the preceeding 10 years. While visiting Brastagi in 1926 I noticed some *Boleti* growing under the young pines. Fig. 2 shows one of these pines with a number of *Boleti* growing from the soil beneath the branches the native is holding. The same fungus is shown on a larger scale in Fig. 3. It was identified as the same species as that which occured at Takengon and Siboelangit.

During a journey in Central America I recently (1928) had the opportunity to observe similar phenomena in the Guatemala high-

lands. On certain soils of this region true conifer forests often occur consisting wholly of pines and other needle trees. In one forest area (elevation 1800 m.) where *Pinus cubensis* is apparently the only pine present a *Boletus* appears rather abundantly near the close of the rainy season. This *Boletus* occurs here under conditions which remind one of the cases just cited in Sumatra. It is quite likely that in this instance also a similar connection exists. However, I did not have time while in Guatemala to investigate the matter further, so I am unable to give any details.

It can hardly be doubted but that an examination would demonstrate both the Guatemala and Sumatra observations to represent typical cases of mutual symbiosis paralleling those which have been shown to exist between certain coniferous trees and the genus *Boletus* in Europe.

Guatemala City, June 1929.

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BLODRISKAN, EN GRANENS FÖLJESVAMP.

AV

LARS-GUNNAR ROMELL.

Sedan mykorrhizafrågan under de senaste åren kommit i ett helt nytt läge genom Melins epokgörande undersökningar, kunde det synas rätt intresselöst att numera samla fältiakttagelser för att belysa frågan om de naturliga symbiosförhållandena mellan svampar och träd. Likväl kan det just på grund av Melins resultat hävdas, att fältiakttagelser fortfarande äro viktiga. Melin har funnit olika grad av affinitet mellan de möjliga symbionterna och urskiljer från denna synpunkt hos en och samma trädart mykorrhizasvampar av första och andra ordningen, av vilka de senare sannolikt ha en underordnad betydelse under de normala konkurrensförhållandena i den fria naturen och endast i undantagsfall spela en roll som mykorrhizabildare. Ett sådant fall föreligger enligt Melin exempelvis beträffande den av mig tidigare (1921) behandlade smörsoppen, som enligt laboratorieundersökningarnas resultat kan bilda mykorrhiza, förutom med tallarter, även med lärkar och måhända med gran (Melin 1923, 1925), men som i naturen åtminstone i vissa trakter torde vara bunden till tallar.[1]

[1] Jfr förutom min nyssnämnda uppsats växtplatsuppgifterna för smörsopp t. ex. hos Quélet 1888, Bigeard-Guillemin 1909, Rolland 1910, Maublanc 1921. Den tämligen enhälliga uppfattningen av smörsoppen som en tallsvamp i fransk litteratur är visserligen föga bevisande, då ju granen spelar så föga roll i Frankrike. Av motstridande uppgifter är väl Michaels (1918) särskilda omnämnande av unga »Fichtenanpflanzungen», medan tallen ej alls nämnes, den märkligaste. I senare upplagor av Führer für Pilzfreunde är emellertid detta ändrat: svampen anges nu som följesvamp till vanlig tall (»Kiefer») och bergtall (»Knieholz») samt har blivit »selten unter Fichten» (jfr Michael-Schulz 1924 nr. 85).

Fältiakttagelser över de olika mykorrhizasvamparnas sätt att uppträda bilda därför ett nyttigt komplement till de exakta laboratorieundersökningarna. De äro ägnade att öka vår ännu bristfälliga kunskap om vilka av de överhuvud möjliga svampsymbioserna verkligen spela en roll i naturen, såväl generellt som under olika betingelser.

För att samla dylika iakttagelser av verkligt värde fordras likväl, om man ej är i besittning av en LINNÉS observationsförmåga, att man vet eller anar, vad som är särskilt angeläget att observera.[1] Avsikten med dessa rader är att med stöd av några egna iakttagelser leverera en slags arbetshypotes till ledning för fortsatta iakttagelser över blodriskans (läckra riskans, *Lactarius deliciosus*) förekomstsätt och att stimulera intresset hos tidskriftens läsare för den kulinariskt såväl som biologiskt intressanta frågan, till vilka träd denna välbekanta och lätt igenkända art under olika betingelser uppträder som följesvamp.

Det må förutskickas, att MELINS syntesförsök med blodriskan givit positiva resultat med bergtall, tall och gran samt att svampböckernas och florornas uppgifter beträffande artens växtplatser mestadels äro diffusa och ofta ta sikte på markens eller markvegetationens beskaffenhet snarare än på närvaron av någon viss trädart. I huvudsak synes dock enighet råda om att blodriskan är en barrskogssvamp. »Barrskog» rätt och slätt uppgives t. ex. av QUÉLET 1888, BIGEARD-GUILLEMIN 1909, ROLLAND 1910, ROMELL 1907 och 1917, MAUBLANC 1921; samma med något tillägg t. ex. av FRIES 1860 (»något fuktiga gräsbeväxta platser i b.»), KARSTEN 1879 (»b., på gräsbev. plats.»), ROMELL 1898 (»b. bland gräs»), MICHAEL 1918 och MICHAEL-SCHULZ 1924 (» ... på fuktiga, mossiga skogsängar ... bland enbuskar och ljung»), GRAMBERG 1921 (b., särskilt »in jüngeren Fichtenschlägen», men även på hedar, i torra gläntor, på fuktiga skogsängar). ROMELL 1901 har däremot helt kort »gräsbeväxta ställen i skogarna», och THESLEFF anger: »barrskog, lärkträdsskog, alskog, fuktiga

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Vid en kritisk granskning av växtplatsuppgifterna i tysk litteratur är det kanske skäl att tänka på den vacklande användningen av ordet »Fichte» i folkspråket som en möjlig felkälla (i vissa trakter avses därmed tall i stället för gran). Härmed vill jag naturligtvis ej bestrida möjligheten, att smörsoppen under vissa naturförhållanden skulle kunna uppträda som en mer eller mindre viktig gransymbiont (jfr KALLENBACH sid. 47).

[1] Exempelvis en hel del uppgifter om smörsopp i samband med andra träd än tallar ha sannolikt av denna anledning knappast något större indicievärde.

ängar».[1] Bestämda trädslag (inkl. enen), som jag under mitt (föga systematiska) sökande i litteraturen funnit nämnda i samband med blodriskans växtplatser, äro för övrigt: en (»Wacholdertriften», RICKEN; MICHAEL, se ovan), lärk (RICKEN), tall (»Moorkiefern», MICHAEL-SCHULZ) och gran. Den sistnämnda har jag dock till min stora förvåning sett särskilt nämnd endast sporadiskt: hos PETERSEN 1895 (»oftest mellem Græs i Randen af unge Granplantager») och 1907 (»I Skove og Parker, navnlig i Randen af unge Granplantager»), RICKEN (». . . Fichtengebüschen»), GRAMBERG (»in Nadelwäldern, namentlich in jüngeren Fichtenschlägen . . .»), och slutligen hos LANGE, vilken i bjärt motsats mot alla andra uppgifter jag kunnat finna (om icke möjligen PETERSENS tidigare) upptar blodriskan i sin lista av e x k l u s i v a[2] gransvampar. LANGES hittills, efter vad det vill synas, allenastående uppfattning om artens uppträdande i Danmark stämmer fullständigt med den jag småningom bildat mig om dess förekomst i Stockholmstrakten, och jag vill nu redogöra för vad som lett mig till denna uppfattning.

Till en början är det i Stockholms skärgård särdeles lätt att konstatera, att blodriskan i denna trakt är en exklusiv barrträdssvamp. Den är ytterst vanlig i barrträdszonen, ej minst i dess yttre delar. Åtminstone i Upplandsskärgården, som jag känner bäst, tycks den rentav vara särskilt rikligt förekommande i den yttersta barrträdszonen, måhända beroende på att bättre humusformer (jfr nedan) förhärska i samband med den ökade tendensen till uppkomsten av mer eller mindre lövängsliknande blandskogstyper och överhuvud gräsrika typer. Utanför detta optimum i yttre barrträdszonen (t. ex. på Blidö) är det emellertid tvärt slut. Sålunda har blodriskan aldrig träffats på Svartlöga[3], vare sig av

[1] THESLEFFS ofta märkvärdiga lokaluppgifter förklaras därav, att hans bekanta studie gick ut på att registrera svampfloran i olika skogssamhällen, representerade av utvalda typbestånd, visserligen så rena som möjligt, men »rent bestånd» är ett relativt begrepp.

[2] Att detta är meningen, sluter jag av att namnet ej står inom parentes; listan åtföljes nämligen av följande not: »Names in brackets indicate species which, although characteristic of the tree in question, are not absolutely confined to it.» Indirekt synes härav framgå att övriga (ej inklamrade) arter verkligen befunnits »absolutely confined».

[3] N.B. på huvudön! Tyvärr känner varken lektor PEHRSON eller förf. svampfloran på det bergiga Skäret, som vi blott sällan besökt och aldrig för att plocka svamp; en beklaglig lucka, ty d ä r f i n n s g r a n, visserligen endast få och dåliga exemplar.

förf. eller av lektor Torsten Pehrson, som likaledes är ivrig svampplockare och vistats på ön åtskilliga somrar. Markförhållandena inklusive fuktigheten äro likväl å en så stor del av Svartlögas areal efter okulärbedömning idealiska för blodriskan, att man nästan kan våga påstå, att svampen borde finnas där, om den i trakten överhuvud kunde uppträda som följesvamp till vare sig al (jfr Thesleff) eller en, båda ymnigt förekommande ön runt. Frågan är då vad som fattas. På Svartlöga (huvudön!) saknas granen fullständigt, men även tallen är representerad blott i några få[1] exemplar på ett enda ställe. Svartlöga erbjuder alltså ingen nämnvärd variation av ståndorter med tall, och riskans frånvaro[2] även i och omkring den lilla talldungen kan tänkas bero på markfaktorer (ehuru det ej ser så ut). I alla händelser är en jämförelse enbart mellan Blidö och Svartlöga otillräcklig för att övertygande belysa blodriskans förhållande till tallen. Ett systematiskt genomforskande av de större och mindre öarna närmare Blidö under en riskornas högsäsong skulle däremot sannolikt ge ganska upplysande resultat[3], men det hade jag tyvärr ej klart för mig, medan jag ännu hade tillfälle att göra det.

Den iakttagelse, som först övertygade mig om att blodriskan i Stockholmstrakten är en speciell följesvamp till granen, ligger nämligen betydligt längre fram i tiden, ehuru den nu är sju år gammal. Då jag med min familj för åtta år sedan flyttade till Djursholm, upptäckte vi till vår glädje, att vår tomt för sin storlek var en synnerligen givande svampmark. Första hösten kunde vi bl. a. skörda en hel del blodriskor. Följande vinter företogs en gallring i det i vårt tycke alltför täta trädbeståndet (bestående av tall med insprängd björk, asp, gran och sälg), varvid förutom en ringa del av tallbeståndet samtliga granar borttogos. Sedan dess har blodriskan ej kunnat återfinnas, trots det att tomten systematiskt genomsökts varje år. Den övriga

[1] Visserligen icke endast två, som E. Almquist förlåtligt men felaktigt tolkat min mindre precisa uppgift »ett par»; det är en liten grupp eller dunge bestående av några få (jag minns ej hur många) gamla, bredkroniga tallar.

[2] Stället har passerats mångfaldiga gånger under riskans tid av både lektor Pehrson och mig.

[3] Detta är blott ett exempel på en av de många frågor, som skulle kunna belysas genom ingående studier i yttre skärgården, och på de uppgifter, som vänta den ekologiska station därute, som väl någon gång måste komma till stånd i ett så intressant område, där naturen ofta isolerat faktorer, arter och individer på ett sätt, som direkt inbjuder till biologiska studier av mångfaldig art.

svampfloran (nu som första året bestående mest av kremlor) är fortfarande riklig under säsongen vid lämplig väderlek.[1] Det förtjänar ytterligare anmärkas, att ett av våra bästa riskställen befinner sig helt nära, utmed en granhäck inom Djursholms bebyggda område, och att när riskorna där framkommit i mängd (senast nu de sista augustidagarna 1930), vår egen tomt plägat genomsökas särskilt noga för att kontrollera, om blodriskan verkligen definitivt försvunnit.

På grund av dessa erfarenheter har jag alltsedan hösten 1923 vid alla lägliga tillfällen haft min uppmärksamhet riktad på blodriskans sätt att förekomma och har aldrig träffat den annat än där gran funnits så nära, att man kunnat förvänta närvaron av granrötter i marken. Tyvärr är ej observationsmaterialet så stort som önskligt vore, ty jag har ej haft så mycket tid att ströva i skogarna och plocka svamp. Tidigare hade jag ej min uppmärksamhet fäst på saken och kan därför ej uppge, hur det förhåller sig t. ex. med det i min uppsats 1921 sid. 208 meddelade fyndet i en talldunge nära Fiskebäckskil.[2]

Så mycket synes mig tydligt, särskilt med tanke på Langes överensstämmande erfarenheter från Danmark, att alla eventuella fynd av blodriskan i otvivelaktig frånvaro av gran (liksom alla fynd av smörsopp i säker frånvaro av tall) förtjäna att noga registreras och publiceras t. ex. i denna tidskrifts borgisavdelning. Det är ju mycket möjligt att, om icke Langes och min uppfattning överallt bekräftas, det kommer att visa sig, att förhållandena mer eller mindre lagbundet växla från trakt till trakt, vilket kunde ge intressanta uppslag till vidare undersökningar av skogligt och allmänt biologiskt intresse.

Till slut några ord om blodriskans övriga krav på ståndort, som avspeglas i svampböckernas »gräsbeväxta ställen i skogarna»,

[1] Då ingen förteckning gjordes, kan jag tyvärr ej uppge, om någon annan av de svampar, som numera sökas förgäves på tomten, fanns före granens borttagande. Jag skulle tro, att så var fallet åtminstone med *Russula Queletii* (jfr Lange), som under en god kremlesäsong knappast sökes förgäves vid någon granhäck inom den närmaste omgivningen. Anmärkningsvärt är att *Cantharellus aurantiacus* (jfr Lange) finns kvar på tomten (kontrollerat nu i sept. 1930, nära åtta år efter granavverkningen). Den växer bland tallbarr under en grupp av tre tallar med underväxt av rönn, ek, måbär och en.

[2] Dr. Hj. Östergren har haft vänligheten att på förfrågan meddela, att gran växer i den ena av de två dungar, varifrån mina 1921 anförda uppteckningar härstamma.

»fuktiga, mossiga skogsängar» etc. Jag tror, att det väsentliga i saken kan sammanfattas därhän, att blodriskan ej trivs i verklig råhumus, utan blott i vissa bättre humusformer. Å andra sidan synes en ren, hård gräsvall vara mindre fördelaktig än en blandning av gräs med mossor, sådana som *Hylocomium squarrosum*. Svampens förkärlek för fuktigare ståndorter synes vara mest utpräglad uppåt Norrland och bottnar måhända även i kravet på bättre humusformer. På Gotland (efter iakttagelser vid Tjelders i Boge socken) framkommer den visserligen ofta tidigare i kärrkanter än på andra ställen, men under sin högsäsong är den ingalunda inskränkt till dylika ståndorter utan träffas rikligt på f. ö lämpliga ställen även i torra hagar. Mer eller mindre påfallande skillnader emellan olika trakter kan man konstatera i flera svampars sätt att förekomma. Så tycks vårmusseronen i Stockholmstrakten förekomma uteslutande i hård gräsvall och helst å öppna ängar, men vid Tjelders träffas den företrädesvis bland barr under enbuskar. Dylika skillnader sammanhänga troligen i regel med olikheter i betingelserna för humusbildningen, beroende på olika kalkhalt i marken eller olika klimat.

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Resümee.

Der echte Reizker, ein Fichtenbegleiter.

Trotz der Errungenschaften der experimentellen Mykorrhizaforschung behalten Beobachtungen in der Natur über Parallelvorkommen von Pilzen und Bäumen ihre Bedeutung. Sie sind immer noch wertvoll zur Beleuchtung der Frage, welche der physiologisch möglichen Symbiosen von ökologischer Wichtigkeit sind.

Nach Verf:s Beobachtungen scheint der echte Reizker (*Lactarius deliciosus*) in der Stockholmer Gegend ebenso treu an Fichten (*Picea*) gebunden zu sein wie der Butterpilz (*Boletus luteus*) an Kiefern (*Pinus*-Arten). Besonders eindringlich spricht für erstere Auffassung das beobachtete vollständige Verschwinden des Pilzes nach Wegnahme der wenigen Fichten in einem gemischten Kiefernbestand.

Der Auffassung vom echten Reizker als einem exklusiven Fichtenbegleiter wurde früher durch Lange in Dänemark (1923) Ausdruck gegeben.

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OM HUMULUS LUPULUS L. I JÄMTLAND.

av

TH. LANGE.

I fråga om graden av humlens hemortsrätt i Jämtland ha sedan gammalt olika åsikter gjort sig gällande. I allmänhet synes mig nu den uppfattningen vara rådande, att förekomsterna inom landskapet leda sitt ursprung från gamla humlegårdar och att således växten här icke skulle vara att hänföra till de ursprungliga »vilda» arterna. Ända tills i år har jag hyst samma uppfattning. Då jag förut någon gång påträffat humle ute i markerna, har det alltid varit på kortare avstånd från gårdar, där den odlats eller ännu odlas, samt under omständigheter i övrigt, som avgjort tydde på, att den å dessa lokaler endast var en kulturflykting. Under den gångna sommaren har jag emellertid besökt ett par lokaler, där växten med all säkerhet är fullt vildväxande.

Den förste, som nämner *Humulus lupulus* såsom förekommande vild i Jämtland, är Abr. Hülphers. I sin »Beskrifning öfver Jämtland» (V, sid. 187) säger han rörande Lits socken: »Humla är funnen växa vildt på tvenne ställen i Socknen, der Folk aldrig trott. En afskedad Soldat har derifrån tagit rötter och planterat dem vid sitt Torp och fått god Humla.» C. J. Hartman har i sin skildring av Åreskutan (III, sid. 112) även nämnt *Humulus*: »Humlarna på Årskutan tros äga sitt namn af Humlan, hvilken här funnits vildt växande, men hvaraf jag dock vid mitt vistande ej kunde finna annat än torkade stjelkar, emedan den blifvit skadad genom rötters upptagande af folket i bygden, som använde den till anläggande af små plantager. Förmodligen härleder sig denna växt från något hemman, som, nu öde, vid Bergfoten fordom varit anlagdt.» För övrigt har jag i den botaniska

litteraturen rörande Jämtland endast hos Andersson & Birger (I) funnit något uttalande rörande humlens ursprunglighet. På ett ställe (sid. 73) skriva dessa författare: »Vi ha vidare ej upptagit sådana enstaka förekommande arter som humle (*Humulus lupulus*) — — — m. fl., om hvilka det skulle kunna ifrågasättas, att de med människans hjälp förts upp i vissa sydberg, ehuru detta långt ifrån är säkert» samt på ett annat ställe (sid. 111): »Mycket svårtolkade till sitt förekomstsätt äro *Humulus lupulus* i Åreskutan och Öjeberget i Hälsingland samt — — —. Ett någorlunda säkert uttalande om dessa måste fotas på vida mera ingående studier af deras hela utbredning och uppträdande än vi kunnat ägna desamma.» Våra floror nämna i allmänhet ingenting om artens ursprunglighet i vårt land. Ett undantag utgör Lindmans flora, där det heter (VI, sid. 228): »I allm. förvild. från gamla humlegårdar.»

Vid ett besök under den gångna sommaren i Sörbygden, Hällesjö socken i sydöstra Jämtland, meddelade befolkningen, att vild humle skulle finnas i trakten, närmare bestämt på en holme i Norrån. Med en intresserad naturvän, hemmansägare O. E. Olsson i Karlsgård, som vägvisare gjordes tvenne besök å lokalen, det ena den $^{22}/_{6}$, det andra den $^{1}/_{8}$.

Ungefär 1 kilometer från sitt utlopp ur Lugnsjön delar sig Norrån i tvenne armar, som bilda små forsar, och som omsluta en holme av cirka $^{3}/_{4}$ hektars yta. Holmen kallas av folket för Kvitsleholmen. Avståndet till närmaste människoboningar, några gårdar i Sörbygden, torde vara omkring 4 kilometer. Själva holmen är synnerligen otillgänglig. Stränderna utgöras i huvudsak av större och mindre stenblock, mellan vilka under årens lopp av förmultnande växtdelar o. d. ett delvis ganska tjockt lager av humusrik mylla bildats, här och där genomskuret av strömmen och bildande djupa vattenfyllda gropar och hålor. En mycket tät och yppig snårvegetation samt massor av mer eller mindre uppruttnade vindfällen bidraga till att göra en promenad runt holmen i hög grad besvärlig. Marken vid stränderna står under våren till största delen under vatten. Det mellersta partiet av holmen är några meter högre och bevuxet med en blandskog av gran, tall och björk.

På sydsidan av holmen vid själva strandkanten har *Humulus* sin växtplats. De lokala förhållandena gjorde det omöjligt att bestämma från huru många rötter de talrika rankorna härstam-

made. Dock konstaterades med säkerhet 5 olika individ; troligen uppgår emellertid antalet till det dubbla. Ett antal vissna revor iakttogos även. På en kullblåst björk funnos dylika av mellan 3 och 4 meters längd. Den $^1/_8$ befann sig humlen ännu i knopp. Endast några få nyss utslagna blommor sågos.

På och i omedelbar närhet av humlelokalen antecknades följande arter. [Nomenklatur i enlighet med Holmberg, Skandinaviens Flora (IV) och Lindman, Svensk Fanerogamflora (VI)].

Alnus incana
Betula pubescens
» *verrucosa*
Daphne Mezereum
**Lonicera Xylosteum*
Populus tremula
Prunus Padus
**Ribes alpinum*
» *Schlechtendalii*
Rosa cinnamomea
Rubus idaeus
Salix caprea
» *nigricans*
» *pentandra*
» *phylicifolia*
Sorbus Aucuparia

Actaea spicata
Agropyron caninum
Aracium paludosum
Athyrium Filix femina
Calamagrostis purpurea
Carex gracilis
» *inflata*
**Circaea alpina*
Dryopteris Phegopteris
Filipendula Ulmaria
Melica nutans
Phalaris arundinacea
Poa nemoralis
Valeriana excelsa
**Viola mirabilis*

De flesta av dessa voro för övrigt spridda i holmens hela blockzon, i vilken dessutom bl. a. följande arter förekommo:

Calla palustris
Carex caespitosa
» *loliacea*
» *vesicaria*
Convallaria majalis
Corallorrhiza trifida
Cystopteris fragilis
Dryopteris austriaca
Mentha arvensis v. *lapponica*
Naumburgia thyrsiflora
Paris quadrifolia
Peucedanum palustre
Polygonatum verticillatum
Scutellaria galericulata
Struthiopteris Filicastrum

I mossan på stenarna i själva forsen växte **Sedum annuum.*

Samma dag jag gjorde det sista besöket å Kvitsleholmen, besökte jag även den i Ragunda socken belägna s. k. Humleforsen, varifrån P. Olsson (VII, sid. 114) uppgivit humle. Den del av Singsån, som fått sitt namn av humlen, ligger mellan Middagsbergets sydligaste utlöpare och landsvägen mellan Håsjö och Ragunda, ungefär halvannan kilometer nedom den gård, som å generalstabskartan kallas »Väffabriken». Denna fors föreföll åtskilligt mera »civiliserad» än Norråns, i första hand beroende på att en timmerränna byggts i densamma, varvid omgivningarna säkerligen påverkats något. Efter en stunds letande påträffades en humlelokal, även denna belägen på en holme, som dock var av be-

tydligt mindre dimensioner än Kvitsleholmen. Hela ytinnehållet torde knappast uppgå till mer än 4—500 kvadratmeter. Holmen var bevuxen med buskar, men saknade Kvitsleholmens oländiga blockterräng. Marken höjde sig endast någon meter över vattnet, varför större delen av holmen på vårsidan torde vara översvämmad. Endast några svaga på marken krypande humlerevor anträffades. Efter vad jag sedan hörde av en person från trakten, skulle jag icke ha funnit den förut kända lokalen, som lär ligga på norra stranden längre ned utefter ån.

I floran på humlelokalen å den lilla holmen ingingo bl. a. följande arter:

Alnus incana
Betula pubescens
**Lonicera Xylosteum*
Prunus Padus
Ribes Schlechtendalii
Rosa cinnamomea
Rubus idaeus
Salix caprea
» *nigricans*
» *phylicifolia*
Sorbus Aucuparia
**Viburnum Opulus*

Calamagrostis purpurea
Carex gracilis
» *inflata*
» *vesicaria*
Dryopteris Phegopteris
Filipendula Ulmaria
Melica nutans
Mentha arvensis v. *lapponica*
Naumburgia thyrsiflora
Paris quadrifolia
Phalaris arundinacea
Poa nemoralis

Aconitum septentrionale
Agropyron caninum
Aracium paludosum

**Rumex aquaticus*
**Scirpus silvaticus*
Valeriana excelsa

I ett sel strax ovan forsen förekom rikligt blommande **Butomus umbellatus.*

Artsammansättningen å de båda humlelokalerna är ju i stort sett ganska lika. Av buskarna och träden äro 60 % gemensamma. I artlistorna ingå en del sydliga arter, betecknade med *, vilka giva belägg på det kända förhållandet, att stränderna av åar och bäckar, särskilt vid forsar, ofta hysa ett antal mera värmefordrande arter, vilka annars äro sällsynta i trakten. Tydligen är det det rinnande vattnet, som på något sätt verkar temperaturreglerande (jfr II, sid. 226) och som troligen även inverkar gynnsamt på själva markunderlaget.

Att man på de ovan omnämnda humlelokalerna har att göra med fullt ursprungliga växtsamhällen, i vilka humlen ingår såsom ett naturligt element, är höjt över allt tvivel, och humlens

»vilda» förekomst inom landskapet torde i och med detsamma få anses vara fastslagen. Det är mycket troligt, att fortsatta undersökningar komma att påvisa humle såsom ursprunglig å flera Jämtlandslokaler.

Hülphers uppgift från Lit torde bliva svår att kontrollera, då närmare lokal icke angives. P. Olsson har emellertid (VIII, sid. 136) upptagit en lokal därstädes, Östra Halåsen, där jag dock förgäves sökt växten. På humlarna vid Åreskutan har jag heller icke iakttagit den. Slutligen återstår en lokal, å vilken förekomst av vildhumle förefaller mig synnerligen trolig, nämligen Skalsberget i Ströms socken, där den enligt E. A. Selberg (IX, sid. 103) förekommer »ymnigt». Berget är av sydbergsnatur, beläget långt inne i ödemarken på ungefär en halv mils avstånd från människoboningar och hyser en flora, i vilken, även enligt Selberg, en del sydliga element ingå.

För övrigt har jag av lantbefolkningen fått åtskilliga mera svävande uppgifter om vildhumles förekomst inom landskapet, uppgifter, vilkas riktighet jag så småningom kanske kan få tillfälle till att undersöka.

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TILL KÄNNEDOMEN OM INVANDRINGEN AV BETA MARITIMA L. VID SVERIGES VÄSTKUST.

AV

HERMAN G. SIMMONS.

Under de första åren av 1900-talet konstaterades *Beta maritima* L. första gången som en ny medborgare i den svenska floran, om man nämligen ej medräknar en del fynd av arten som anthropokor vid hamnar och ej heller det tillfälliga uppträdandet av förvildade kulturformer av betor. Sådana anthropokora förekomster kunna ju visserligen äga sitt intresse, ehuru arten aldrig torde kunna bliva annat än en efemerofyt, en tillfällig gäst, där den med människans hjälp kommit in på växtplatser, som lätt nog äro utsatta för att förändras i för *Beta* mindre gynnsam riktning, t. ex. genom uppkomsten av en tät och kanske också högvuxen vegetation. I den följande översikten av svenska *Beta*-fynd har jag därför lämnat alla sådana förekomster ur räkningen.

Beträffande utbredningen av *Beta maritima*, så är den sedan gammalt känd från västra Europas, Medelhavets, Röda havets och Indiska oceanens stränder. Den går också in till Svarta havet och uppgives i Kaukasus gå upp i bergen. Dock torde det vara osäkert, om denna och andra angivna inlandsförekomster rätteligen äro att föra till *Beta maritima*, eller om det icke här snarare är fråga om andra, närbesläktade arter. Vid Europas atlantiska kust sträcker sig *Beta*'s utbredning upp till Irland, där arten allmänt förekommer vid stränderna, samt till Skottlands västkust. I den under utgivning varande stora Cambridge-floran angives den nordligast för Hebriderna, men enligt Watsons Cybele Britannica skall den vara funnen även på Orkney- och Shetlandsöarna. Den finnes vidare på bägge sidorna av Kanalen och fortsätter till Bel-

giens kust samt utefter Englands och Skottlands östra kust upp till Fifeshire. Vidare finnas enstaka uppgifter från Hollands och Tysklands Nordsjökust, under det den synes saknas vid Jyllands västkust. I Langes danska flora finnes den visserligen angiven därifrån, men inga exempelar i Köpenhamn bestyrka uppgiften. Om icke något misstag föreligger, torde den därför vara att hänföra till ett tillfälligt uppträdande. Däremot är *Beta* känd från sammanlagt ett 60-tal lokaler längre österut i Danmark, huvudsakligen vid Store Bælt och angränsande farvatten. Jag har ej haft tillfälle att eftersöka, när den först blev omnämnd från Danmark, men i Hornemanns Forsøg til en Dansk Økonomisk Plantelære, Ed. II, 1806, angives den såsom känd från en enda lokal, Halen vid Marstal på Ærø. Sedan har emellertid Lange i sista upplagan av sin danska flora kommit upp till 15 växtplatser (uppgiften från Jyllands västra kust ej inberäknad). Den ytterligare ökning av de kända danska växtplatsernas antal, som framgår av den bifogade kartan, vilken godhetsfullt uppgjorts och ställts till mitt förfogande av amanuensen Johannes Grøntved, kan ju bero på en noggrannare undersökning av de danska kusterna, men även om en sådan nog torde ha sin andel däri, förefaller det dock knappast sannolikt, att en så pass stor och iögonenfallande växt på alla dessa lokalar så länge kunnat undgå botanisternas uppmärksamhet, om den vore gammal på dem. Snarare är jag böjd för att antaga, att den är stadd i spridning i Danmark, liksom den otvivelaktigt är vid vår västkust.

För de första fynden av spontan *Beta* i vårt land har redogjorts i ett par uppsatser i denna tidskrift 1907 och 1908 (Gunnar Andersson, Om förekomsten av Beta maritima på Sveriges västkust; H. G. Simmons, Några ord om de svenska fyndorterna för Beta maritima L., samt Beta maritima på de skånska fyndorterna). Åtskilliga vid skånska kusten gjorda fynd behandlas här, och i Gunnar Anderssons uppsats omnämnes även växtens anträffande samma sommar i Göteborgs skärgård. Senare har *Beta* ytterligare upptäckts på ett flertal punkter vid halländska och bohuslänska kusten (Fr. E. Ahlfvengren, Några växtgeografiska notiser från Halland, Sv. Bot. Tidskr. 1910; Th. Lange, Kärlväxtfloran i Styrsö socken i Göteborgs och Bohus län, ib. 1912; Fritz Helgesson, Beta maritima i Styrsö skärgård, ib. 1913; Harald Fries, Bidrag till kännedomen om floran i Göteborgs och Bohus län, Meddelanden från Göteborgs Botaniska Trädgård, 1924 och 1928; Sten

Svensson, Halländska växtlokaler, ib. 1928; T. Borgvall, Växtgeografiska bidrag från Göteborgsområdet samt angränsande delar av Västergötland och Halland, ib. 1928; Bertil Lindquist, Nya skånska växtlokaler, Bot. Not. 1930). I Ahlfvengrens Hallands växter anföras också ett par nya växtplatser, och i Johan Wiger, Adventivfynd och växtlokaler från Halland, Bot. Not. 1926, finnes en uppgift, som dock torde gälla en anthropokor förekomst och sålunda ej böra komma i betraktande här. För flertalet av fyndorterna angivas endast enstaka exemplar, för några dock ända till ett tiotal eller mera. Att den åter försvunnit från ganska många av de rätt talrika växtplatser, dit den under de senaste 30 åren invandrat, är otvivelaktigt, men på några ställen finnes den fortfarande, och särskilt gäller detta en del lokaler i Göteborgs skärgård. Jag skall emellertid i den följande sammanställningen av de svenska *Beta*-lokalerna söka angiva såväl det antal individ, som på varje ställe anträffats, som också så vitt möjligt konstatera, huru kolonisationen i varje fall lyckats. Anledningen till försvinnandet, där sådant kan anses säkert, skall i det följande också tagas i övervägande, så vitt det låter sig göra.

Tillkomsten av en ny medborgare i den svenska floran, oberoende av den omfattande och ständigt pågående anthropokora invandringen, är ju något så pass ovanligt och intressant, att jag helt naturligt, sedan jag 1907 och 1908 gjorde *Beta*-fynden vid Mölle och Alnarp, alltjämt intresserat mig för artens invandring i Sverige och haft den i tankarna, då jag besökt strandlokaler, där den möjligen kunde tänkas förekomma. Ända till innevarande år har jag dock ej lyckats upptäcka någon ny *Beta*-lokal, och det beredde mig därför en synnerligen angenäm överraskning, då jag under den sistförflutna sommaren kunde konstatera, att en ny kolonisation, i betydligt större skala än förut, ägt rum under de senaste åren. Under en vistelse i Lerhamn vid Krapperup i juli råkade jag en gång i slutet av månaden vid en vandring utefter stranden söder om Nyhamnsläge, där jag ofta varit under föregående somrar, och där jag just konstaterat, att det stora beståndet av *Eryngium maritimum* fortfarande finnes i behåll, få syn på ett exemplar av *Beta*. Detta fynd föranledde en närmare undersökning av lokalen, som medförde ytterligare upptäckter, sammanlagt 14 individ, därav flera stora och kraftiga samt åtminstone tre med inflorescensgrenar. Till blomning hade dock vid den tiden intet av dessa ännu hunnit.

Då jag sedan kom att nämna fyndet för min bror, ingenjör Otto Simmons, meddelade han mig, att han sett en beta vid stranden norr om hamnen, och en undersökning av detta strandparti medförde upptäckten av ytterligare bortåt ett tiotal, till större delen ganska små plantor, dock även ett par rätt kraftiga. Detta gav i sin ordning anledning till sökande närmare Lerhamn, varvid ungefär halvvägs mellan bägge lägena åter ett tiotal kunde antecknas. Mest överraskande var dock, att inne vid hamnen i Lerhamn, där jag minst av allt väntade något sådant fynd, påträffades ej mindre än 15 individ, därav några kraftiga plantor med rätt långt utvecklade inflorescensgrenar. Vid bukten norr om hamnen funnos sedan två plantor, den ena först efter min avresa upptäckt av dr. Emil Lindell.

Tyvärr var jag nödsakad att lämna Lerhamn vid månadens slut och kunde ej, såsom jag önskat, fortsätta sökandet efter *Beta* ända bort till Mölle, men jag lyckades dock före min avresa spåra upp ytterligare ett par växtplatser, dels ungefär halvvägs mot Vattenmöllan (10 individ), dels vid bukterna nedanför Vattenmöllan (14 ind.). Sedan jag rest, fortsatte emellertid min hustru, fru Karin Simmons, och min dotter Gerda sökandet efter *Beta* ända fram mot Mölle och lyckades öka antalet upptäckta individ högst avsevärt, nämligen från 73, som jag i allt funnit, till 137. De 64 nyupptäckta individen funnos dels ganska sparsamt fördelade på ett flertal småbukter, dels i större antal vid den s. k. Fåglaviken vid Mölle, där bl. a. en del synnerligen stora och kraftiga plantor med inflorescensgrenar iakttogos. Sedermera har dr. Lindell meddelat mig, att han under fortsatt sökande funnit ytterligare 9 plantor dels vid Mölle, därav några stora inne vid hamnen, dels en söder om de av mig vid Nyhamnsläge observerade, och slutligen två vid Strandbadens badhus. I allt uppgår alltså antalet antecknade individ till 146 utefter den omkring 6 km långa strandsträckan från Mölle hamn till Strandbaden. Frågan om framtidsutsikterna för denna omfattande nya kolonisation skall senare behandlas.

I det följande har jag sökt åstadkomma en fullständig sammanställning av de svenska *Beta*-lokalerna och fynden samt de i de offentliga herbarierna föreliggande exemplaren (jfr fig. 1). Årtalet för det första fyndet på varje växtplats har därvid angivits, liksom vad som är känt om kolonisationens senare fortbestånd och så vitt möjligt antalet funna individ. Beträffande förekomsterna i Göteborgs skärgård och i Bohuslän står jag i tacksamhetsskuld till ämneslärare

Fritz Helgesson och dr. Harald Fries, som lämnat mig en del förut opublicerade uppgifter, och jag har även att tacka professor The Svedberg och direktör Hugo Plengier för meddelanden om ett par nya bohuslänska fyndorter. I sammanställningen av fyndorterna hava följande förkortningar kommit till användning: F. A. = Fr. E. Ahlfvengren, H. F. = Harald Fries, F. H. = Fritz Helgesson, E. L. = Emil Lindell, H. G. S. = Herman G. Simmons, K. S. = Karin Simmons, S. S. = Sten Svensson, h. G. = Göteborgs botaniska museums och trädgårds herbarium, h. L. = Lunds botaniska institutions herbarium, h. S. = Botaniska riksmuseums herbarium, h. U. = Uppsala botaniska institutions herbarium. Lokaluppgifterna äro ordnade söderifrån norrut.

Skåne.

Lomma socken: Alnarp, H. G. S. (l. c.) 1908, 1 individ; har ej senare kunnat återfinnas. Flädie s:n: Bjerred, E. Broddesson 1906 (H. G. S., l. c.); redan 1908 åter försvunnen. Landskrona 1920, O. R. Holmberg (h. L.). Hälsingborg: Pålsjö strand 1921, G. Samuelsson (h. S., h. U.), Th. Lange (h. G.), 1922, A. S. Trolander, T. Sjövall och U. Tilly, enligt meddelande av apotekare Trolander; Tinkarp 1920, O. R. Holmberg (h. L.), ett individ, enligt meddelande av A. S. Trolander; 1921, T. Sjövall (h. G.); samt ett sannolikt anthropokort uppträdande utan närmare angiven fyndort 1907, Th. Sjövall (h. L., h. S., h. G.). Allerums s:n: Hittarp, ett exemplar 1919, B. Lindquist (l. c., h. L.), försvunnen redan 1920 och senare förgäves eftersökt. Brunnby s:n: Strandbaden, 2 individ 1930, E. L.; nedanför strandskogen, 1 ind. 1930, E. L.; söder om Nyhamnsläge, norr om den långa »ören» mot Strandbaden, 14 ind. 1930, H. G. S.; norr om hamnen i Nyhamnsläge, 8 ind. 1930, O. Simmons och H. G. S.; halvvägs mellan Nyhamnsläge och Lerhamn, 11 ind. 1930, H. G. S.; hamnen i Lerhamn, 15 ind. 1930, H. G. S. och E. L.; bukten norr om hamnen, 2 ind. 1930, H. G. S. och E. L.; halvvägs mellan Lerhamn och Vattenmöllan, 10 ind. 1930, H. G. S.; småbukterna nedanför gårdarna vid Vattenmöllan, 14 ind. 1930, H. G. S.; i bukterna på sträckan från Vattenmöllan till Fåglaviken vid Mölle samt vid denna vik, 64 ind. 1930, K. S., därav de flesta vid Fåglaviken; söder om hamnen i Mölle, 1 ind. 1930, E. L.; vid Mölle hamn, 4 ind. 1930, E. L.; nedanför Skansarna vid Mölle, 2 ind. 1907, H. G. S. (l. c., h. L.), därav det ena kraftigt med långa grenar och riklig fruktutveckling, det andra svagare men dock blommande, försvunnen 1911 (?). Barkåkra s:n: Ängelholms hamn (Skeldervikens stationssamhälle) 1907, enligt Gunnar Andersson (l. c.) tagen av L. Améen; i ett privatherbarium (dr. E. Lindells, numera i postmästare U. Tillys ägo) finnes också ett exemplar, taget av G. Theorin samma år (och på samma lokal?) från »Engelholm», vilket torde beteckna hamnen, ej staden: vidare ett exemplar i h. S. från stranden mellan badorten (Skelderviken) och Skepparkroken 1907, Sten Selander; Magnarp 1906, fyra individ, E. Broddesson (H. G. S., l. c., h. L.); på lokalerna vid Skelderviks-stranden förgäves eftersökt av dr. Thorild

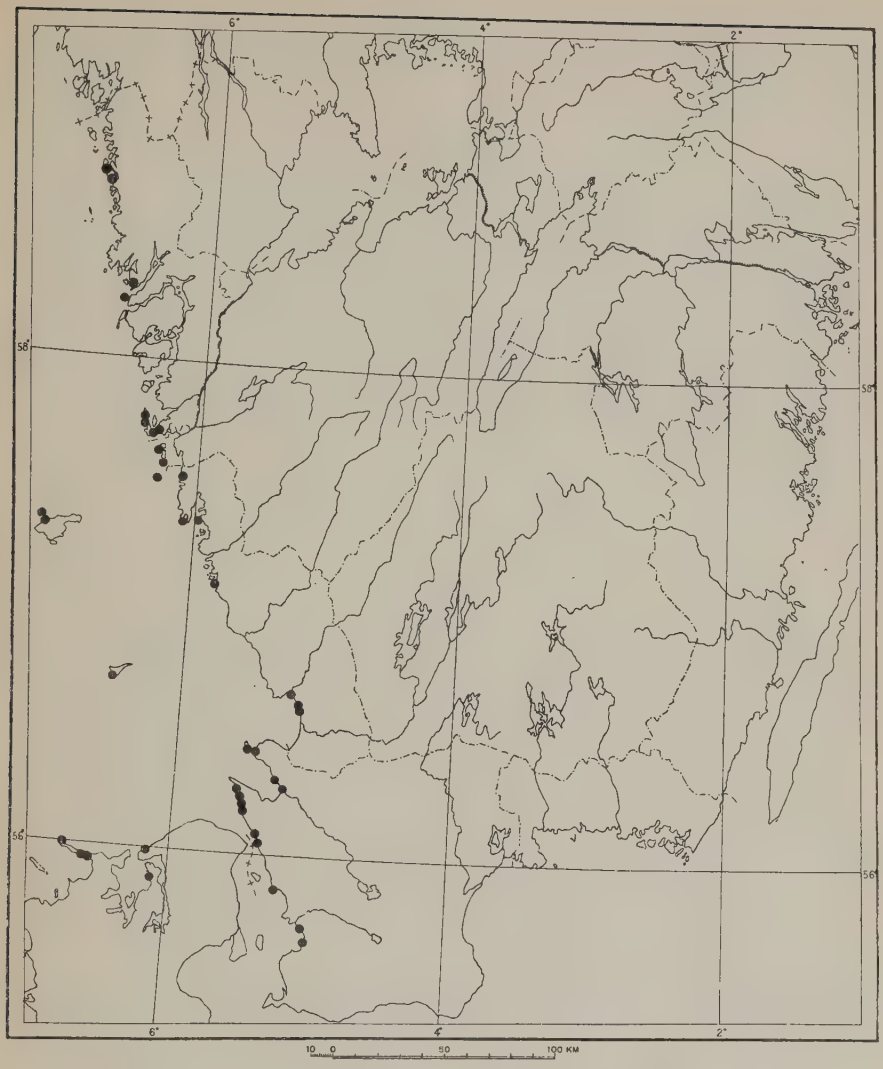

Fig. 1. Karta över utbredningen av *Beta maritima* vid Sveriges västra kust. Några danska lokaler även angivna.

Wulff 1908 och sannolikt utgången. Torekovs s:n: Torekov 1916, Th. Sjövall (h. L., h. G., h. U.); Hallands Väderö, en grupp av unga individ funnen av dr. L. Holmström (h. L.), enligt (den av O. Nordstedt skrivna) etiketten 1891, men enligt Holmströms uppgift till mig, om jag ej missminner mig, 1901; förgäves eftersökt av Wulff och troligen snart åter försvunnen. Sammanlagt bli de skånska lokalerna åtskilligt över 20, om man nämligen räknar de skilda förekomsterna på sträckan Strandbaden—Mölle var för

sig, vilket torde vara fullt befogat, och det samlade individantalet långt över 150, eller sannolikt mera än på samtliga nordligare västkustlokaler tillsammans.

Halland.

Eldsberga s:n: stranden 1907, F. A. (l. c. 1910), ett tiotal individ; senare uppgifter saknas. Snöstorps s:n: vid Fylleåns utlopp 1905, F. A. (l. c. 1910), 1 ind., ej sedan återfunnen. Halmstad: östra stranden vid svinslakteriet 1903—1906, F. A. (l. c. 1910), flera exemplar, senare sannolikt utgången; vid vågbrytaren 1911, F. A. (l. c. 1924), antal ind. ej angivet (h. G., h. S.), senare upplysningar saknas; härtill kommer en uppgift av J. Wiger (l. c.) från barlastplats vid Lotshyddan 1924. Varberg: H. Wistrand 1923, ett exemplar (enligt S. S., l. c.). Ölmevalla s:n: Örmanäs strand 1912, S. S. (enligt F. A., l. c. 1924). Onsala s:n: Malön 1911, F. A. (l. c. 1924; h. G., h. S.). Släps s:n: Maleviken 1927, E. Erlandsson (enligt S. S., l. c.; ex. h. G.), Maleviken på västra stranden 1927—1928, T. Borgvall (l. c.), ett stort exemplar. Senare uppgifter saknas i allmänhet för de halländska lokalerna.

Västergötland.

Styrsö s:n: Yttertistlarne. Här upptäcktes 1910 av ämneslärare Fritz Helgesson några kraftiga och rikt förgrenade individ. Th. Lange (l. c.) kunde 1911 ej återfinna växten, men enligt F. H., l. c., funnos detta senare år ett tjugotal individ, delvis med meterlånga grenar. Herr Helgesson har, då jag tillskrivit honom om ytterligare upplysningar, haft vänligheten även nu i höst besöka lokalen och har meddelat, att *Beta* fortfarande finnes kvar samt sänt mig några fotografier, av vilka en här reproduceras. Han fann då 16 individ, ehuru ej på alldeles samma plats som förut. Växten skall enligt meddelande av lotsarna och fyrpersonalen ej ha synts till under de senaste åren, men kan ju lätt ha förbisetts av dem. Herr Helgesson anser också troligt, att den på den ursprungliga platsen spolats bort under en storm. I h. L. och h. G. är lokalen representerad av exemplar tagna av C. N. Holmdahl 1915. *Beta* är här vidare iakttagen under en av Göteborgs Botaniska Förening 1924 företagen exkursion (H. F., l. c.), varvid den ansågs hotad, då får utsläppts på ön. Den har ju emellertid hittills kunnat hålla sig kvar. Vargö 1907, Th. Lange. Lokalen är först publicerad av Gunnar Andersson (l. c.), dock utan närmare angivande av individantalet. Lange (l. c.) uppger sig emellertid vid ett senare besök 1908 ha räknat 19 ind., 1909 och 1911 dock blott ett ind. varje gång, men den är tagen där senare. Exemplar: Th. Lange 1907 (h. L.), 1908 (h. G.), A. H. Magnusson 1916 (h. G., h. U.), H. Fries 1928 (h. G.), R. Ohlsén 1928 (h. G.). H. Fries omnämner också (l. c.), att 1928 anträffades två individ, det ena ett praktexemplar med talrika rikt blommande grenar, det mindre med 10—12 halvmeterlånga skott. Han är dock ej säker, huruvida det här gäller samma växtplats som den ursprungligen av Lange funna. Vrångö 1928, A. Frisendahl, enligt meddelande av H. Fries.

Bohuslän.

Torslanda s:n: Hjuvik 1926 (h. G.) och 1927 (h. G.) J. Ericsson, enligt meddelande av H. Fries. Öckerö s:n: västra sidan av Grötö 1927, C. T. Holmström (h. G.); även följande år, men nu utgången enligt meddelande av H. Fries; Hyppeln 1930, säkert minst 10 individ, upptäckt vid Göteborgs Botaniska Förenings vårutflykt enligt meddelande av H. Fries; Rörö 1930, funnen av A. Frisendahl enligt meddelande av H. Fries; även tagen av en skolyngling, John Tholén, enligt meddelande av H. Plengiér. Skaftö s:n: Tjellsö (yttre delen av Gåsö) 1930, H. Plengiér, bortåt 10 individ; Lilla Långholm 1930, H. Plengiér, ett individ. Lyse s:n: Skalhamn 1930, 3—4 individ; Ålvik 1930, ett stort individ. Bägge dessa lokaler ha meddelats mig av dr. H. Fries, som upptäckt dem. Tanums s:n: Grebbestad, Sövall, 1 ind. 1913; nordvästa sidan av Hällsö, 1 individ 1930. Dessa bägge lokaler, de nordligaste på vår västkust, ha upptäckts av professor The Svedberg, som meddelat mig dem. J. E. Palmér upptar i sin Bohusläns Flora inga nya lokaler.

Enligt den förestående sammanställningen är *Beta* således nu känd från ett 40-tal svenska växtplatser, om än från ganska många, sannolikt de flesta, åter försvunnen. Detta hindrar ju emellertid icke, att den i stort sett kan förmodas vara stadd i spridning vid vår västkust. I förbigående kunna också en del i herbarierna representerade *Beta*-förekomster på barlastplatser och dylika ställen nämnas. De äro från den nordligaste, Skönvik i Medelpad, räknat: Söderhamn, Ljusne, Gävle (den äldsta svenska *Beta*-uppgiften 1810), Skutskär, Norrköping, Klintehamn, Kalmar, Malmö, Hälsingborg, Halmstad, Göteborg. Det kan också förtjäna nämnas, att i h. S. ligger ett exemplar från Grönlien vid Oslo, taget 1885 av R. E. Fridtz. Fyndet synes ej vara publicerat, men har ju ett visst intresse, då *Beta* annars aldrig torde ha uppmärksammats i Norge.

Där blott enstaka individ funnits, kan växten naturligtvis lätt försvinna igen, och detta synes ju ha inträffat på alla de skånska lokalerna från invandringsperioden närmast efter 1900. Där emellertid ursprungligen ett större individantal upptäckts, skulle man ju snarare kunnat tänka sig, att *Beta* borde hava utsikt att varaktigt hålla sig kvar på lokalen, åtminstone under förutsättning av att denna erbjöd någorlunda gynnsamma existensbetingelser. Så har ju också skett i Göteborgs skärgård; på de ungefär från samma tid stammande fyndorterna därstädes, där flera individ från början uppträdde, har den lyckats fortfarande behålla sin plats. Anmärkningsvärt är emellertid, att de ursprungliga individen mestadels (alla?) äro borta, och att nya kommit upp i när-

heten. *Beta* är ju perenn, och individen borde kunna påräkna längre livstid än några få år, men olika ogynnsamma omständigheter kunna ju ha spelat in. Vid Mölle, där jag fann den 1907, funnos två individ, som blommade och satte frukt både då och under ett par följande somrar. Ehuru fruktsättningen var riklig, och väl utvecklade frön funnos i mängd, stodo inga fröplantor att upptäcka, sannolikt emedan växtplatsen ej var fullt lämplig för groning och utveckling. Att de stora individen försvunno, kan åtminstone beträffande det längst kvarstående, största och kraftigaste, knappast bero på annat, än att det förstörts av en hänsynslös växtsamlare. Möjligen gäller detta också andra fyndorter, men annars torde de ursprungliga plantorna ha försvunnit genom avbetning, utspolning, nedsandning eller övertäckning med tång eller annan drift.

Växtplatsens beskaffenhet, strandens art, synes nämligen spela en stor roll för *Beta*, ej blott för groning och utveckling av fröplantor, utan också för individens fortsatta existens. Såsom Gunnar Andersson (l. c.) framhåller, är *Beta* företrädesvis en blockstrandsväxt. Åtminstone gäller detta för de skandinaviska förekomsterna; annars kan den också uppträda som klippväxt; exempelvis har professor Svedberg meddelat mig, att han i Cornwall sett den gå högt upp i strandklipporna i sällskap med bl. a. *Asplenium marinum*, *Cotyledon Umbilicus* och *Aster Tripolium*. Visserligen kan den uppträda även på sandig eller grusig strand, men torde där ha mindre utsikt att hålla sig kvar i längden. Det kan därför vara av intresse att sammanställa, vad som kan angivas om de olika fyndorternas beskaffenhet. Jag skall därvid börja med de nya lokalerna vid Kullahalvöns sydkust, som på grund av kolonisationens omfattning stå i en klass för sig. De äro emellertid av olika beskaffenhet. Söder om Nyhamnsläge växer *Beta* på ren sandstrand tillsammans med *Atriplex littorale* m. fl. arter, *Salsola Kali* samt en del andra, som äro att betrakta som tillfälliga invandrare på stranden. Vegetationen är gles och öppen. I lokalens beskaffenhet ligger en stor fara för nedsandning eller utsköljning. Att så många och delvis stora och kraftiga plantor funnos, torde stå i samband med att de senare åren varit ovanligt stormfria. Skulle emellertid en starkare nordväststorm inträffa[1], så att sjön spolar

[1] Sedan detta skrevs, har vid Kullens fyr en vindstyrka av 36 m uppmätts i början av oktober. Då nordvästlig vind rådde, har *Beta* sannolikt redan blivit illa åtgången i bukten söder om Nyhamnsläge.

ända upp till *Elymus*-vegetationen, vilket är ganska vanligt på vintern, är det att förutse, att *Beta* ej kan stå emot, utan antingen begraves under uppkastad sand eller sköljes ut. Lerhamnslokalerna äro någorlunda liknande, även där växer *Beta* i sand, men på grund av vida bättre skyddat läge torde den dock ha rätt goda utsikter att hålla sig kvar. Stranden vid Fåglaviken är en kombination av sand- och blockstrand och torde även erbjuda ganska gynnsamma betingelser, då den är någorlunda skyddad, om än icke för betning. På sandstrand med öppen vegetation och uppkastad tång finnes ju också en god groningsbädd och möjlighet för fröplantor att utveckla sig.

De övriga nyupptäckta fyndorterna äro alla rena blockstränder, alltså de norr om Nyhamn belägna liksom de mellan Lerhamn och Fåglaviken. Sand finnes i allmänhet icke här, utan mellan och under stenarna finnes merendels lera, och *Beta*-plantorna växa i mellanrummen mellan blocken, ofta ganska stora sådana, där de äro väl skyddade, då kreaturen helst undvika blockstranden. På sin höjd kunna plantorna utsättas för att höljas av uppkastad tång och annan drift — diasporerna ha ju kommit dit med sådan — men substratet är stabilt. Vegetationen är mycket gles och sparsam; jag observerade i sällskap med *Beta* knappast andra växter än *Tussilago Farfara*, *Taraxacum*, *Rumex crispus* (relativt talrika rosetter), vidare *Cochlearia*, *Aster*, *Agropyrum repens* samt möjligen en eller annan ytterligare i enstaka exemplar. Vid Vattenmöllan, där små bäckar rinna ut i bukterna, växte utom några av de förut anförda *Ranunculus sceleratus*, *Polygonum*-arter m. fl. tillsammans med *Beta*. På en del ställen, särskilt norr om Nyhamnsläge fortsätter blockmarken med övergång i klapperfält innanför stranden och hyser bl. a. *Crambe maritima* i riklig mängd. Här borde ju *Beta* också kunna växa och torde väl sprida sig dit, om den får fast fot vid stranden och kan alstra större mängder av frö. Beträffande Fåglavikslokalen föreligga inga anteckningar om vegetationens sammansättning, liksom ej heller rörande växtplatsen inne vid Mölle hamn, som dock är av ganska ren blockstrandsnatur.

Den gamla *Beta*-lokalen vid Mölle får visserligen också närmast betecknas som blockstrand, men såsom jag angivit i min uppsats 1908, fanns dock där en mera strandängsartad växtlighet, som torde ha varit hinderlig för uppkomsten av fröplantor utom just på de barfläckar, där *Beta*-stånden växte. Vid Alnarp växte det enda iakttagna individet på en fläck, där sanden spolats bort, så

att moränen blottats, och liknande torde förhållandet ha varit vid Bjerred. Åtminstone på det senare stället uppkom snart åter en tät och högvuxen ört- och gräsvegetation — bl. a. *Atriplex littorale* i massor — och i denna var betan givetvis dömd att kvävas. Angående Landskrona-, Hälsingborgs- och Hittarpslokalernas beskaffenhet föreligga inga uppgifter, men med kännedom om strandens natur närmast norr om Hälsingborg torde man kunna räkna med att *Beta* där kommit in på ganska lämpliga växtplatser och borde kunna hålla sig kvar, om den får stå i fred för åverkan. Lokalerna vid Skelderviken torde genomgående vara blockstränder. Gunnar Andersson (l. c.) anger ju detta för den ena, och på etiketten till det av Selander tagna exemplaret i h. S. angives »bland rullstenar . . . med *Atriplices*, *Cakile maritima*, *Agrostis* sp. etc». Magnarpslokalens natur var dock enligt Broddessons uppgifter något annorlunda. Om beskaffenheten av växtplatsen vid Torekov är ingenting känt, och stränderna däromkring äro rätt olikartade, bestående dels av sand, dels av småsten eller block. Emellertid synes ju *Beta* överallt vid Bjäre-stränderna åter ha försvunnit, då den ej kunnat återfinnas på de angivna växtplatserna, där den dock eftersökts. Fyndplatsen på Hallands Väderö är enligt Holmströms uppgift till mig alltför avvikande från alla normala *Beta*-lokaler, för att man skulle vänta sig, att den kunde leva kvar där. Den fanns nämligen på ett gräsbevuxet fält, ganska långt från själva stranden. Huru den kommit dit kan knappast ens bli föremål för gissning.

Rörande de halländska lokalernas beskaffenhet och vegetation finnas i litteraturen inga som helst upplysningar. Däremot kan jag, tack vare de utförliga uppgifter, som F. Helgesson lämnat mig, meddela en ganska ingående beskrivning av den sydligaste fyndplatsen i Göteborgs skärgård, Yttertistlarne, där han först fann *Beta* 1910 tillsammans med *Atriplex littorale*, *Matricaria inodora* **maritima* och *Suaeda maritima*. På den ursprungliga platsen var den visserligen i september 1930 försvunnen, och en tät vegetation av *Artiplex latifolium* täckte området, men på en annan fläck i närheten återfann han *Beta*, 12 små individ i en, såsom bilden (fig. 2) visar, tät vegetation av *Matricaria inodora* **maritima*, *Rumex crispus*, *Plantago maritima*, *Agrostis stolonifera* var. *maritima*, *Sonchus arvensis*, *Potentilla anserina*, *Lotus corniculatus*, *Vicia Cracca* och *Angelica littoralis*. På ett annat ställe i närheten funnos fyra individ. Hittills har således *Beta* i 20 år lyckats hålla sig kvar

på Tistlarne, men rätt stor risk för dess försvinnande föreligger nog, om ej nya, mindre tätt bevuxna fläckar uppstå och erbjuda möjlighet för utveckling av fröplantor. I sluten vegetation trivs den ju nämligen icke. Beträffande lokalen på Vargö skriver dr. Fries, att *Beta* växte mellan kullerstenar, således förmodligen på en för arten lämplig växtplats. Rörande Vrångö-lokalen finnes intet angivet om vegetationens beskaffenhet.

Foto F. Helgesson, sept. 1930.

Fig. 2. *Beta maritima* på Yttertistlarne.

Angående ett par av de bohuslänska lokalerna föreligga heller icke närmare uppgifter om vegetationen eller ståndortens natur. Detta gäller Hjuvik och Grötö. Däremot meddelar direktör Plengiér, att fyndplatsen på Rörö är sandstrand, medan de bägge Gåsö-lokalerna utgöras av grusig blockmark. På Hyppeln växer *Beta* enligt meddelande av dr. Fries bland kullerstenar, liksom också vid Ålvik, vid Skalhamn på gammal tång bland *Atriplex*. De bägge Tanums-lokalerna äro enligt meddelande av professor Svedberg närmast av blockstrandsnatur.

Hittills har ju *Beta* visat sig reda sig bäst på vissa av växtplatserna i Göteborgs skärgård, och det kan ju hända, att det

kommer att förhålla sig så även i fortsättningen, men om jag överhuvud skall inlåta mig på det vanskliga företaget att förutspå något om dess framtid som svensk växt, skulle jag dock vilja framhålla, att den flerstädes på de nyupptäckta lokalerna norr om Nyhamnsläge, liksom mellan Lerhamn och Mölle torde ha synnerligen goda utsikter att hålla sig kvar, om den bara får stå i fred och sätta frukt. Där har den ju nämligen kommit in på blockstränder, där den ej behöver lida av någon övermäktig konkurrens genom växter, som kunna bilda en tät och skuggande vegetation, och den bör äga möjlighet att även utbreda sig på innanför liggande klappermarker; delvis torde den också föga utsättas för åverkan genom betande djur. Även en del av sandstrandslokalerna torde kunna visa sig utgöra goda växtplatser, särskilt kanske Lerhamns hamn och Fåglaviken. Klimatet bör ju också vara gynnsamt både för kvarlevande av en gång uppvuxna plantor och för fröutveckling. Sommaren är ju säkert lång och varm nog för frömognad — jag har åtminstone en gång vid Mölle iakttagit välutvecklade frukter med mogna frön — och vintertemperaturerna torde ingenstädes vid västkusten bli nog låga att äventyra *Beta*-plantornas bestånd. Om så vore, borde detta ju i lika hög grad gälla en del av de nordligare danska lokalerna, där arten dock numera hållit sig i ganska många år.

Ett starkt markerat drag i uppträdandet av *Beta* vid Kullahalvöns kust är, att den är helt inskränkt till bukterna, på de talrika utskjutande uddarna, som samtliga äga blockstrandsnatur, söker man den förgäves. Då växtligheten där för övrigt ej är av någon från bukternas och de mera jämnt förlöpande strandpartiernas avvikande karaktär, måste man tydligen söka förklaringen i olikartade invandringsmöjligheter. Man finner också lätt nog, att smärre driftföremål huvudsakligen kastas upp i bukterna, där man även företrädesvis finner tångbäddarna. Härtill kommer ytterligare ett förhållande, som man ej kan undgå att lägga märke till, nämligen att *Beta*-plantorna äro samlade mot buktens sydkant och saknas på dess nordsida. Detta gäller lokalerna på bägge sidor om Nyhamnsläge liksom samtliga på sträckan Lerhamn—Fåglaviken. Det blir alltså på de mot nordväst exponerade strandpartierna, som man får söka *Beta*, och orsaken är otvivelaktigt att frukterna drivit in med nordvästliga vindar. Hamnarna i Lerhamn och Mölle utgöra endast skenbart undantag, ty på grund av inloppets belägenhet blir det även här nord-

västen som sätter in drift. Något liknande gäller också Fåglaviken, där dock en gång inkommen drift liksom i hamnarna kan kastas upp på vilken punkt som helst, som erbjuder möjlighet därför.

Beträffande fyndorterna inåt Öresund kan något motsvarande icke påvisas. De enstaka exemplar av *Beta*, som där påträffats, måste härstamma från frön, som först efter en lång drift råkat hamna på dessa punkter, och vindriktningen har knappast kunnat vara av någon avgörande betydelse för deras transport dit. Detsamma torde kunna sägas om fynden vid Skelderviken, och beträffande de halländska förekomsterna saknas uppgifter om lokalernas exposition. Lokalerna utanför Göteborg och vidare norrut utefter Bohuslän ligga mer eller mindre långt in i skärgården, och någon lagbundenhet i uppträdandet av *Beta* där torde ej kunna skönjas. Detta är i viss mån beklagligt, ty man skulle annars möjligen därav kunna vinna en viss ledning för bedömandet av härkomsten av de *Beta*-frön, som åstadkommit invandringen av arten vid vår västkust.

Att *Beta* har ström och väl framför allt vind att tacka för sin spridning till Sveriges västkust, är otvivelaktigt. Det ligger ju också närmast till hands att tänka på en spridning från de danska växtplatserna, ehuru en drift tvärs över Nordsjön från de skotska lokalerna också är en möjlighet, som ej kan a priori förnekas. Om en sådan transport ägt rum, borde den ju emellertid i främsta rummet ha medfört en invandring i Norge, dit vägen är avsevärt kortare än till de svenska västkustlokalerna. Driften skulle ju också ha passerat förbi den norska sydväst- och sydkusten, där något fynd av *Beta* aldrig synes ha gjorts. Man torde därför få räkna med härkomst från Danmark såsom given, även om naturligtvis en del av de svenska växtplatserna kunna för sin tillkomst ha att tacka frötransport från en annan förut koloniserad västkustlokal. De iakttagelser över *Beta*-diasporernas flytförmåga, som M. J. Mathiassen gjort (Om Beta maritimas Udbredelse ved Store Bælt, Botan. Tidsskr., Bd. 22, 1899, sid. xiv), synas ju också tala emot möjligheten av den flerdubbelt längre transporten över Nordsjön, men man får, som Gunnar Andersson (l. c.) framhåller, kanske ej för mycket generalisera innebörden av dessa observationer. Man får ju också räkna med att ej blott enstaka dichasier utan också större delar av blomställningen kunna komma i drift, kanske insnärjda bland andra föremål, som kunna hjälpa till att hålla dem uppe

under en längre drift. Att *Beta* kan vandra över havssträckor av 100 km eller mera, är ju i alla händelser bevisat genom kolonisationen vid den svenska kusten, där de flesta lokalerna ligga på omkring 100 km avstånd eller längre från närmaste danska växtplats.

Att *Beta* ej förr än i detta århundrade upptäckts i Sverige, torde ha sin förklaring däri, att den först ganska nyligen fått sin nuvarande, relativt vidsträckta utbredning i Danmark. Att den emellertid inkommit oftare och på flera ställen, än där botanister observerat den, torde kunna tagas för givet, ty enstaka individ, som hamnat på en olämplig växtplats, kunna ju lätt försvinna igen utan att åstadkomma någon spridning i trakten. Härom tala de av Mathiassen (l. c.) anförda iakttagelserna av ett 100-tal unga plantor på en halvmilslång kuststräcka, där växten ej förut funnits, ett tydligt språk, då redan året efter så gott som hela kolonien förstörts genom utsköljning vid en storm.

Visserligen får man väl utgå ifrån att de nordligaste danska lokalerna, som ligga närmast vår västra kust, huvudsakligen ha varit av betydelse för dennas kolonisering, men även den totala utbredningen i Danmark kan ju i detta sammanhang vara av intresse, och då jag har att tacka amanuensen Grøntved ej blott för den här reproducerade kartan (fig. 3) över förekomsterna av *Beta maritima* i Danmark utan också för en fullständig förteckning över samtliga numera kända lokaler, torde det vara lämpligt att här lämna en redogörelse för artens samtliga växtplatser i Danmark, däribland även sådana inbegripna, där den ej på senare tider återfunnits. Även här har så vitt möjligt året för den första upptäckten på varje plats angivits, men jag har ej ansett erforderligt att anföra finnarens namn eller citera publikationer; däremot har för de i Köpenhamns botaniska museums herbarium representerade lokalerna angivits »h. K.». De numera i Danmark kända fyndorterna för *Beta maritima* äro enligt de uppgifter, som amanuensen Grøntved haft vänligheten lämna mig, i huvudsak ordnade från norr till söder, följande:

Jylland.

Hirtsholmene (h. U.): Tyvholmen och Græsholmen 1888, Tyvholmen 1904 (h. K.), 1928 (h. K.); Grenaa, Hornemann (h. U.); Jernhatten 1909; Aarhus 1888; Marselisborg strand 1921; Kalvømade strand 1914 (h. K.).

Læsø.

Nordre Rønner 1899 (h. K.), 1928 (h. K.); Ræpynt vid Vesterø hamn 1925 (h. K.).

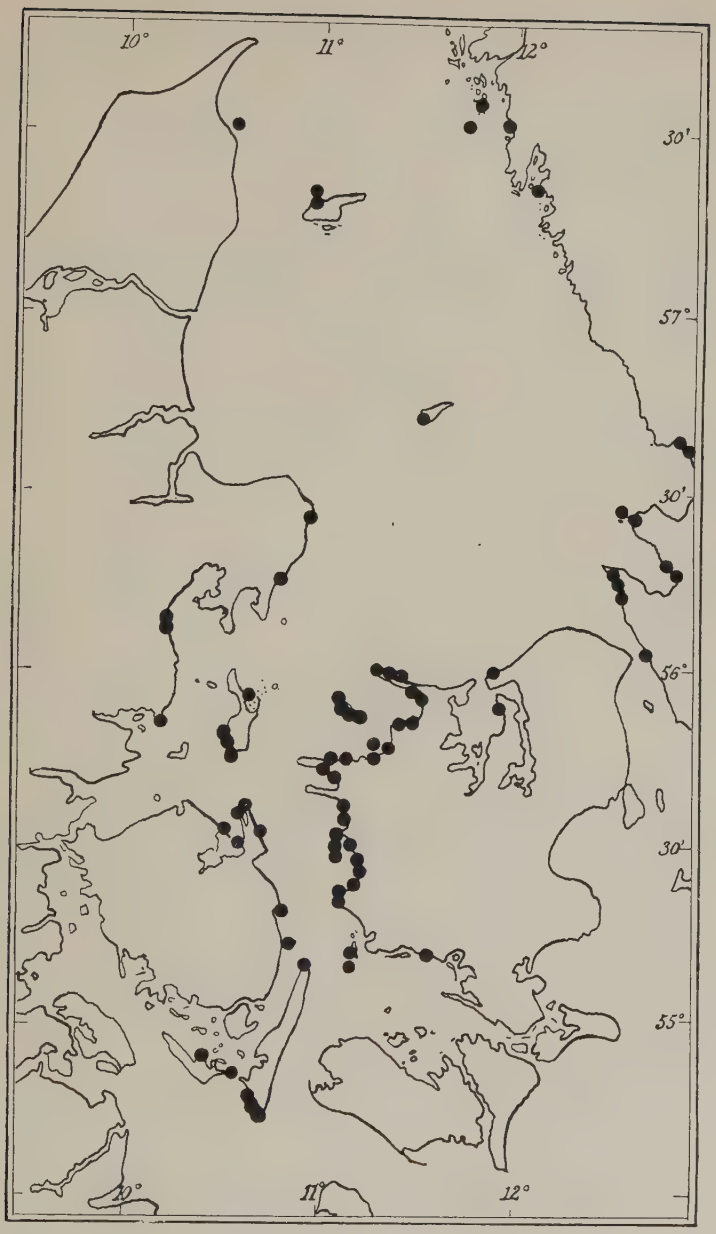

Fig. 3. Karta över utbredningen av *Beta maritima* i Danmark. Några svenska västkustlokaler även angivna.

Anholt.

På sandstrand söder om hamnen 1930 (h. K.).

Samsø.

Lilleøre vid Langøre 1908 (h. K.), Vestborg 1872 (h. K.), 1894 (h. K.), Koldby Kaas 1887 (h. K.), strand söder om Koldby Kaas 1918 (h. K.), mellan Koldby Kaas och fyren 1891.

Fyn.

Nordstranden vid Hoffmansgave 1910; Hindsholm 1848 (h. K., h. U.), Fyns Hoved (Drejet) 1888 (h. K.), 1894 (h. K.), 1911, 1917; Langø 1848 (h. K.); Midskov 1901 (h. K.); Nyborg 1873 (h. K.), 1923 (h. K.); Vresen, i stor mängd enligt Hornemann 1837, men numera försvunnen.

Ærø.

Utan lokaluppgift 1843 (h. K.); Ourehoved vid Ærøskøbing 1858 (h. K.); Marstal 1860; Halen vid Marstal den äldsta danska lokalen, angiven redan 1806 av Hornemann.

Langeland.

Frankeklint 1906 (h. K.), nordvästra kusten 1906; Bagnkop 1860, 1870 (h. K.), 1872, 1903 (h. K.); mellan Bagnkop och Dovnsklint 1905; Dimesodde 1903 (h. K.).

Sjælland.

Kikhavn 1916 (h. K.), Jægerspris 1916; Sjællands Odde: allmän vid Gniben (1897) och spridd utefter uddens norra strand samt på sträckan Bjerghuse—Høve strand—Ebbelykke sydstrand—Sonnerup strand; strand nordväst om Veddinge 1927; Sejrø 1896 (h. K.), allmän längs södra stranden, på den norra blott vid Snerup; Nexelø; Saltbæk 1865 (h. K.), strand norr om Saltbæk och Saltbæk Vig 1877 (h. K.), 1896 (h. K.); vid Kysthospitalet på Refsnæs, 1890 (h. U.), 1927 (h. K.), sydsidan av Refsnæs 1899, 1900 (h. K.); Stold 1907 (h. k.); Stillinge 1899; Mulen vid Kallundborg 1867, Kallundborg 1927 (h. K.); Svallerup strand 1876 (h. U.), 1879; Drossellyng strand; Osen vid Gørlev 1930; Reersø 1859 (h. K.), 1860 (h. K., h. U.), 1865 (h. K.), 1866 (h. K.), 1899, 1924 (h. K.); Nordholm; Musholm; Mullerup Havn 1899; Drøsselbjerg—Bildsø 1891; Frølunde Fed—Korsørs fästning 1847 (h. K.); Korsør 1852 (h. U.); Lejodde 1925 (h. K.); Aggersø, på västsidan 1874, 1924 (h. K.); Omø; Gumperup Klint 1879.

Härtill komma ytterliggare fynd från Sjælland, Klampenborg (h. U.); Amager, Kløvermarken; Bornholm, Nexø kyrkogård (numera försvunnen) och från Sønderborg på Als, men på samtliga dessa ställen är *Beta* säkerligen införd på anthropokor väg, varför lokalerna här sakna intresse. Möjligen förhåller det sig på samma sätt med en av Prahl i Kritische Flora der Provinz Schleswig-Holstein etc. lämnad uppgift. Han citerar nämligen Hornemann 1837 för ett fynd vid Heiligenhafen i Holstein, där växten numera är

försvunnen, men enligt Prahls uppfattning skulle varit spontan, i motsats till vad han uppger om en annan anförd lokal.

Den äldsta kända *Beta*-lokalen i Skandinavien är ju Halen vid Marstal på Ærø, men det är ej därför säkert, att detta faktiskt är den första punkt i Danmark, där växten kommit in. Man känner ju från Hornemanns och Drejers tid även några andra fyndorter, och det kan ju tänkas, att arten vuxit på någon av dessa, innan den upptäcktes på Ærø. Emellertid vinnes intet genom att inlåta sig på dylika spekulationer, ty den frågan kvarstår ändå: hur har *Beta* kommit till sin första växtplats i Danmark? För en invandring med hjälp av ström och vind ligger ju Hirtsholms-lokalen bäst till, men så vitt man kan döma av föreliggande iakttagelser, torde den ej ha kunnat med drift från andra sidan Nordsjön finna sin väg dit, och dess frånvaro i Norge talar ju också emot ett sådant antagande. Men därmed uteslutes också möjligheten för att räkna med en spontan invandring till någon av de sydligare danska fyndorterna, dit vägen är längre och dessutom går fram i krokar genom mer eller mindre smala sund, där ju frukterna måst ha varit utsatta för att kastas upp under passagen.

Då således en spontan invandring till den första danska *Beta*-lokalen synes utesluten, får en annan förklaring till artens nuvarande utbredning sökas. Såsom förut anfört, är ju *Beta* på åtskilliga ställen i Skandinavien, liksom också annorstädes, anträffad såsom anthropokor vid hamnar och liknande platser, varför det ej är orimligt att räkna med att växten först kan ha inkommit med barlast eller dylikt och sedan funnit sin väg till naturliga växtplatser på stränder, och att den efter hand under det århundrade, som förflutit sedan den först upptäcktes på stranden av Halen vid Marstal, skaffat sig sin nuvarande danska utbredning med hjälp av havsdrift, liksom den också på samma sätt från danska lokaler koloniserat den svenska västkusten. Att just Marstal varit den första punkt i Danmark, som *Beta* funnit väg till, torde ha sin förklaring däri, att denna stad av gammalt varit hemort för ett synnerligen stort antal smärre segelfartyg, skonare galeaser m. fl. Att dessa då och då gått hem i barlast, är ju högst antagligt, liksom att en och annan kommit från någon ort på västeuropeisk kust, där *Beta*-frön lätt kunnat komma med i barlastjord. Om detta antagande är riktigt, skulle alltså *Beta* från början ha varit anthropokor i Skandinavien, men den har i Danmark sedan lång tid tillbaka som neofyt ingått i naturliga växt-

samhällen, och vid den svenska västkusten är tydligen samma process nu i gång.

Den nu anförda hypotesen om *Beta maritima*'s invandring i det skandinaviska florområdet är visserligen den, som synes mig ha mest fog för sig, men det kan ej förnekas, att en annan också kan uppställas, vilken skall i korthet tagas i betraktande, nämligen att en kulturform (*Beta vulgaris*) skulle ha kommit ut på den första danska växtplatsen, där den lyckats acklimatisera sig och återgått till vildformen. Den vilda *Beta maritima* är, även om den icke uppfattas alltför kollektivt, en ganska mångformig art; åtminstone har den att uppvisa ganska talrika ståndortsmodifikationer och geografiska raser, enligt vad E. v. Proskowetz anger, vilken ingående studerat dess olika former i samband med sina odlingsförsök, för vilka han redogjort i en serie av uppsatser i Österreichisch-Ungarische Zeitschrift für Zuckerindustrie und Landwirtschaft under 1890-talet. Då denna tidskrift ej finnes tillgänglig i svenska bibliotek, har jag vänt mig till Dipl. Agr. Carl Blom i Berlin, som haft den stora vänligheten att låta framställa fotografiska reproduktioner av de viktigaste av Proskowetz' artiklar och tillställa mig dem. Jag får till honom uttrycka min stora tacksamhet, då jag genom tillgång till Proskowetz' odlingsresultat kan i någon mån belysa frågan om sannolikheten av en återgång till vildformen, där en kulturform råkat komma ut på en strandlokal.

Då Marggraf 1747 offentliggjorde sina undersökningar över sockerhalten i betor, kom han för de vita foderbetorna ej upp till mer än omkring 1,5 % socker, för rödbetor ännu lägre. När emellertid Achard omkring 1800 gjorde de första försöken med fabriksmässig framställning av betsocker, lyckades han få ett något bättre utbyte, omkring 4 %, men den senare betförädlingen har ju varit i stånd att uppdriva sockerhalten i de nu odlade sockerbetorna till i många fall över 20 %, i enstaka betor t. o. m. till 23—24 % (i Tyskland). De betor, som bildade utgångsmaterialet för Achard, Vilmorin m. fl., voro huvudsakligen vita foderbetor, delvis dock också röda, mera långsträckt cylindriska. Den låga sockerhalten hos de då förekommande sorterna torde få anses ha sin orsak däri, att man under betornas långa odlingstid — de uppges ju ha varit kulturväxter redan hos de gamla egypterna — mest fäst avseende vid storleken hos rötterna, ej vid näringsvärdet. Proskowetz anser visserligen, att de bättre resultat med avseende på sockerhalt, som han uppnått hos avkomlingar av vild *Beta*

maritima i jämförelse med de i hans försök ingående typerna av kulturbetor, berott på att de sistnämnda senare tagits med i försöken, men jag är snarare böjd för att antaga, att förklaringen får sökas däri, att han ju lagt an på att direkt ur vildbetorna välja ut sådana stammar, som visat hög sockerhalt, under det att man förr omedvetet valt ut sådana, som haft tendens till särskilt kraftig rotbildning, men ej nödvändigt därjämte till större sockerupplagring, varför de gamla foderbetorna utgöra ett dåligt material för uppdragning av sockerbetor.

Hos den vilda *Beta maritima* torde sockerhalten i de relativt smala rötterna kunna vara avsevärt högre än hos de äldre kulturformerna. Detta kan man sluta av v. Proskowetz' uppgifter, att han redan efter ett par års odling uppnått en medelsockerhalt av 4,7 %. Extremerna voro då 2,2 och 11 %, men några år senare hade han kommit upp till 14 % och mera (hos en beta t. o. m. 15,2 %). Det synes sålunda knappast tvivel underkastat, att han genom några års fortsatta odlingar och urval kunnat uppnå fullt tillfredsställande sockerbetor, men han avbröt sina försök, sedan han påvisat för varje generation stigande framsteg och konstaterat, att någon artskillnad mellan *Beta maritima* och *B. vulgaris* ej kan upprätthållas. Han framhåller, att med stigande tjocklek hos roten även sockerhalten tilltar, beroende på en ökad parenkymmassa och relativt sparsamma kärlknippen, men detta torde hålla streck, endast då blott de sockerrikaste betorna utväljas till förökning. Redan tidigt under försöken uppträdde emellertid rötter med ända till 3,5 cm diameter upptill. Han talar också om rikedomen på olika typer inom det odlade *Beta maritima*-materialet, däribland sådana, som påminte om vissa sockerbetssorter.

Ganska egendomligt är, att Proskowetz vid odling av vildbetan till en början fick övervägande antal redan första året blommande plantor, men att de, som först senare kommo i blomning, år för år ökades, inom vissa stammar ända upp till 98 %. Man borde ju snarare väntat en kraftig vegetativ utveckling och försenad blomning hos de på åkerjord odlade vildbetorna. Men som arten i detta avseende kan förhålla sig olika, berodde möjligen hans resultat på fröets proveniens. På sina naturliga lokaler torde *Beta* så nordligt som hos oss ej komma till blomning förr än tidigast på andra året, detta så mycket mer som dess frö enligt Proskowetz blott undantagsvis gror samma år, som det mognat.

Jag kan tyvärr ej ange åldern för de vid Kullahalvöns strand iakttagna *Beta*-individen, som för övrigt helt säkert förskrevo sig från olika år, men jag skulle vilja tillskriva de större och kraftigare minst ett par års ålder. Likväl fanns i juli — oaktat årets varma försommar — ej ett enda individ, som nått till blomning, endast unga inflorescensgrenar på enstaka kraftiga plantor. I kulturen är ju *Beta* normalt tvåårig, ehuru man stundom lyckats få fröbetorna att leva efter den första frösättningen och blomma om igen, alltså övergå till den hos den vilda strandbetan härskande flerårigheten.

Det kan kanske synas, som om jag med mina hänvisningar till Proskowetz' odlingsförsök väl mycket avlägsnat mig från ämnet, *Beta*-invandringen i Skandinavien, men jag har ansett erforderligt att lämna en sådan motivering för upptagandet av hypotesen om den nordiska *Beta*-utbredningens eventuella härledning från förvildade kulturbetor, och jag skall i detta sammanhang ytterligare nämna, att Proskowetz också anför ett citat från E. Pospichal, Flora des Österreichischen Küstenlandes, där det uppges, att *Beta maritima* ofta förvildas i dessa trakter, och att roten, där växten förvildas eller icke odlas på lämpligt sätt, återgår till den ursprungliga formen och kan bli spolformig eller smalt cylindrisk. Häri ligger således åtminstone ett direkt stöd för antagandet, att den stora adaptivitet och acklimatisationsförmåga, som *Beta* visat i kulturen, också kan göra sig gällande i motsatt riktning, alltså i återgång till vildformen, något som ju också hos andra kulturväxter visat sig kunna förekomma. Om man räknar med att *Beta* genom förvildning kommit till sin första danska strandlokal, får man antaga att frö av foderbeta, rödbeta eller mangold på något sätt hamnat där, ty sockerbetor odlades ju ej på den tiden. Mangold är ju den kulturform, som mest liknar vildbetan, men jag känner ej, om den vid förra århundradets början odlades i Danmark. Den har emellertid genom sin hårdare och torrare rot större förmåga att övervintra i jorden än de köttiga betorna, men man kan nog räkna med att sådana vid förvildning på havsstrand från början fått smalare och mindre parenkymrik rot, som sålunda nog kunnat motstå de köldgrader, som vid södra Östersjön normalt komma i fråga.

Som jag i det föregående sökt visa, torde man således få räkna med att *Beta* på det ena eller andra sätter genom människors hjälp kommit till sin första danska lokal och sedan därifrån

efter hand skaffat sig sin nuvarande utbredning i Danmark. Det återstår nu att ytterligare taga i betraktande vissa drag i dess invandring till Sveriges västkust. Att den kommit dit från Danmark torde utan tvivel med rätta från början hava tagits för givet. Men varför har det krävt ett århundrade efter naturaliseringen i Danmark, innan den kom över till oss, och varför tilltar denna invandring periodiskt? På den första frågan blir utan tvivel svaret, att den först måste vandra norrut vid Store Bælts stränder och bli någorlunda talrik på de nordligaste av de nuvarande danska växtplatserna, innan någon mera omfattande drift av frö till svenska kusten kunde äga rum. Beträffande den andra frågan får först sägas, att periodiciteten i invandringen kanske blott gäller den skånska kusten, ty åtminstone i Göteborgs skärgård har den ju hållit sig kvar sedan den förra stora invandringen för ett 20-tal år sedan, och det låter sig ej avgöra, om någon ny tillförsel under mellantiden ägt rum. Vidare är det endast i Bohuslän, som invandringen synes ha skett huvudsakligen under de sista åren, i Halland är den ju funnen på skilda punkter under en längre tidsrymd, och det kan här mycket väl röra sig om en tämligen kontinuerlig frötransport.

Förmodligen råda ofta nog för överföring till dessa kuststräckor gynnsamma ström- och vindförhållanden, men för tillförsel till skånska kusten krävas särskilt lyckliga omständigheter. Om man räknar med den på *Beta* rika stranden av Sjællands Odde som sannolik ursprungsort för fröna, och därför talar mycket, så fordras ju först, att *Beta*-diasporer genom vind eller kanske snarare översvämning föras ut i sjön och komma i drift, men vidare också att denna går ungefär parallellt med Sjællands nordkust, varefter nordvästliga vindar åstadkomma intransporten och uppkastningen på Skånekusten. Dessa olika gynnsamma betingelser kombineras kanske ej alltför ofta. Gunnar Andersson (l. c.) antyder, att han tänkt på en granskning av de meteorologiska och hydrografiska förhållandena till förklaring av den då kända *Beta*-invandringen, som han är böjd att förlägga till 1905. Att denna tidsbestämning är förhastad, har jag förut (l. c.) framhållit, och det skulle utan tvivel kräva en genomgång av de ifrågavarande iakttagelserna för åtskilliga år, om man vill finna förklaringen till den första invandringen före 1907 och den senaste stora före 1930.

Tyvärr är det emellertid ganska svårt att med hjälp av de me-

teorologiska publikationerna och pegelobservationerna få någon klar bild av bestämda perioder, då *Beta*-invandringen kan anses ha varit särskilt gynnad. Genom välvilligt tillmötesgående av docenten H. Köhler har jag visserligen å Uppsala meteorologiska institution haft tillfälle att taga del av både svenska och danska observationer, men utan att kunna komma till något bestämt resultat. Mest användbara syntes mig emellertid vind- och strömobservationerna från de danska stationerna på fyrskeppen Læsø Rende, Anholts Knob och Schultz Grund, den sistnämnda stationen belägen ungefär mitt emellan Sjællands Odde och den utskjutande delen av Jylland, alltså där nordgående drift från Store Bæltstrakterna måste passera. Man finner av dessa stationers vindiakttagelser, att varje höst eller vinter åtminstone någon gång observerats vind av styrkegrad 10 enligt Beaufortskalan, och att dessa vindar merendels varit sydvästliga eller västliga, vilket är förmånligt för att skaffa *Beta*-frukter ut i drift från Sjællands Odde och giva dem den erforderliga riktningen mot svenska kusten. Härtill kommer, att dessa vindar i allmänhet åtföljts, eller kanske snarare efterföljts, av ganska stark ström, som löpt i ungefär samma riktning som vinden.

Gynnsamma omständigheter för frötransport över Kattegat ha sålunda årligen förekommit, men någon period under åren före 1930, som kunnat särskilt betinga invandring till Skånes nordvästkust, har jag ej kunnat utläsa av observationsserierna. Den stora olikheten i de 1930 iakttagna individens utveckling synes också snarast angiva invandring under olika år, och man får dessutom räkna med olikheter i blomningsintensitet och fruktsättning. En strömhastighet av 2,5—3,0 sjömil i timmen, som rätt ofta förekommit, bör ju emellertid mer än väl räcka till för att föra *Beta*-fröna över till svenska kusten, innan de sjunka.

Då jag härmed avslutar dessa meddelanden om *Beta maritima*'s invandring, särskilt till vår västra kust, måste jag göra det med ett beklagande av att jag ej i år kom i tillfälle att utsträcka mina iakttagelser längre, då ytterligare fynd antagligen kunnat göras närmare Höganäs och kanske också längre söderut mot Hälsingborg. Även Skeldervikens stränder torde vara förtjänta av en förnyad undersökning, möjligen också Laholmsbuktens. Jag hoppas emellertid till ett kommande år ej blott kunna kontrollera, hur den nya kolonisationen lyckats hålla stånd, utan också komplettera årets anteckningar med fynd på andra platser.

Zusammenfassung.

Beta maritima wurde in den ersten Jahren dieses Jahrhunderts zum erstenmal spontan an der Westküste Schwedens gefunden. Auf den ersten Fundorten in Skåne (Schonen) ist die Pflanze zwar wieder verschwunden, aber neue Standorte sind noch weiter nördlich hinzugekommen, und in den Schären von Göteborg hat sie seit 1907 ihren Platz behauptet. Verf. konstatierte nun im Sommer dieses Jahres eine neue, recht umfassende Einwanderung an der Küste von Skåne, von Mölle südwärts, welches zu einer Zusammenstellung aller schwedischen Fundorte Veranlassung gab. Die Verbreitung in Dänemark ist auch in Betrachtung gekommen, weil *Beta* sicherlich von dort ihren Weg nach der schwedischen Küste gefunden. Es ergibt sich, dass die Pflanze auch in Dänemark, seit dem ersten Funde auf Ærø Anfang des vorigen Jahrhunderts, sich stark verbreitet hat. Die dänischen Fundorte sind jetzt etwa 60, die schwedischen mehr als 40, wie aus den Karten ersichtlich.

Beta ist vorzugsweise eine Pflanze des Blockstrandes. Sand- oder Kiesstrand fällt es ihr schwerer, andauernd zu besiedeln. Hieraus erklärt sich teilweise das Verschwinden von vielen bemerkten Fundorten.

Dass *Beta*-Diasporen quer über die Nordsee getrieben und schliesslich ihren Weg nach Ærø gefunden, scheint ausgeschlossen, man muss sich deshalb eine anthropochore Verbreitung dahin denken, und zwei Hypothesen werden aufgestellt, einerseits dass die Früchte mit Ballast eingeführt worden sind, andererseits dass die Pflanze ursprünglich ein Kulturflüchtling gewesen, und dann am Strande in die Wildform zurückgegangen ist. Die erste Hypothese mag wohl die warscheinlichere sein, aber zur Begründung der zweiten werden einige Tatsachen aus der Anbaugeschichte von *Beta maritima-vulgaris* in Überwägung genommen.

Von der dänischen Küste ist die Pflanze später nach der schwedischen hinübergewandert, und es wird diskutiert, welche Wind- und Stromverhältnisse dafür erforderlich sind. Am nördlicheren Teil der schwedischen Westküste scheint eine ziemlich ununterbrochene, wenn auch spärliche, Zufuhr von Samen stattzufinden, an die Küste von Skåne hingegen scheint der Samentransport nur periodisch zu reichen, was davon abhängt, dass dafür eine besonders günstige Kombination von Wind- und Stromverhältnissen nötig zu sein scheint.

Ultuna, Uppsala, Oktober 1930.

SMÄRRE MEDDELANDEN.

Föreningens medlemmar uppmanas, att till denna avdelning insända meddelanden om märkliga växtfynd o. d.

Några märkligare växtfynd.

1. *Myosotis collina* Hoffm. på Bispbergsklack.

Bispbergsklack är ett av södra Dalarnas mest bekanta sydberg, beläget mellan Hedemora och Säter.

Vid ett besök, som jag gjorde därstädes den 13 juni 1930, anträffade jag *Myosotis collina* på tvenne rasmarker inom bergets sydvästra del (= den del av berget, som brukar kallas Vätteklacken). Arten förekom rikligt och i stora exemplar. Tillsammans med den eller i dess omedelbara närhet växte *Myosotis arvensis*, *Geranium robertianum*, *Rubus idaeus*, *Poa nemoralis* m. fl. arter. Strax i närheten funnos också hasselbuskar och alm. — Arten eftersöktes icke vidare inom andra delar av berget, ty exkursionen måste avbrytas på grund av inträdande regnväder.

Berget har tidigare många gånger besökts av botanister. Att *Myosotis collina* icke tidigare upptäckts därstädes torde väl bero, dels på att besöken mestadels (eller alltid?) skett senare på sommaren, när arten förtorkat, dels därpå att den säkerliken endast få gånger finner så gynnsamma villkor för sin utveckling, som den haft 1929—1930. Vårens rikliga nederbörd och värme hade medfört, att det i år fanns livskraftig och friskt grön vegetation också på delar av rasmarken, som jag vid besök tidigare år funnit förtorkade och mer eller mindre nakna.

Arten synes vara ny för Dalarnas flora. Den är också ny för sydbergsfloran inom det område, som avhandlats av Andersson och Birger (1912). Den tidigare kända nordgränsen i Sverige går fram genom Värmland, södra Västmanland (Nora-trakten, socknarna vid Mälaren, Samuelsson 1925), Uppland (karta hos Almquist 1929) och når upp i Gästrikland (några lokaler vid Gävle; Hamrånge socken, Kusö kalv, exemplar i Riksmuseet insamlat av S. Ahlner 1928).

Kröningsswärd (1843) uppräknar arten (under namnet *Myosotis hispida* Schlecht.) såsom indigen medborgare av Dalarnas flora. Han nämner emellertid inga lokaler, vilket annars sker för sällsyntare arter. Vad som gett upphov till Kröningsswärds uppgift synes mig omöjligt att avgöra. Redan Indebetou (1879), som citerar Kröningsswärds uppgift, tillägger:

»Utbredning osäker». Från senare tider föreligger icke heller någon tillförlitlig uppgift om *Myosotis collina* i Dalarna, fastän den floristiska utforskningen av landskapet under senare årtionden bedrivits långt grundligare än förr.

Arten har uppgivits för några landskap utanför området för artens säkra utbredning. Den uppges sålunda vara tagen ett par gånger i Medelpad på barlast (Collinder 1909). Neuman (1887) påstår, att han sett den inom samma landskap i Selånger »troligen inhemsk». Redan om man tar artens säkra utbredning i betraktande, förefaller Neumans uppgift ganska misstänkt. Och då han dessutom meddelar, att han gjort de exkursioner, som ligga till grund för Medelpads-uppgifterna i nämnda uppsats, i augusti och september, måste hans uppgift anses minst sagt dubiös. Neumans hela herbarium brann också upp vid den stora Sundsvalls-branden 1888, varför intet herbariematerial finnes bevarat.

Också från Härjedalen och Jämtland finnas uppgifter om *Myosotis collina*. Fristedt (1854) anger den från byn Wemdalen i Härjedalen. Om artbestämningen över huvud varit riktig, har man all anledning antaga, att det varit en tillfällig förekomst. Birger (1908 *a*) citerar också Fristedts uppgift under rubriken: »Sannolikt införda arter. . .». Enander (Birger 1908 *b*) skall ha sett densamma i Lillhärrdal. Vad som nyss sagts om Fristedts fynd, kan sägas även här. Olsson (1873) uppger den såsom »allmän vid Östersund». Olssons uppgifter äro, som åtskilliga författare påpekat, värdelösa.

2. Två nya fyndorter för *Arctophila fulva* (Trin.) Ands., var. *pendulina* (Laest.) Holmb.

Arctophila är i Sverige tidigare känd från Torneälvens nedre lopp och vidare från några fyndorter i omedelbar närhet av Bottniska viken, också dessa senare samtliga belägna i Norrbotten.

Kustlokalerna äro följande:

Neder Torneå s:n:

Salmis: Salminanti, O. R. Fries, 1858 (R)[1]; Porras udde (i en havsvik), T. Krok, 1868 (R). Enligt upplysningar, som godhetsfullt lämnats mig av kyrkoherde G. Forsström i Haparanda, är Salminanti = östra stranden av Salmis' hamn och Porras (stavas numera Purras) udde = västra stranden av hamnen.

Säivis. Exemplar, som insamlats av O. R. Fries 1858 (U, R) äro enligt etiketten från Seivitz gästgivargård. (Ortnamnets stavning växlar på olika kartor.)

Seskarön, E. Hammarén, 1899 (U, R).

Neder Luleå s:n:

Antnäs, H. Svenonius, 1923 (U, R);

Antnäs Skäret, K. A. Nilsson, 1924 (R).

Från Torneälvens dalgång har jag sett exemplar från följande svenska orter:

Haparanda, flera samlare från olika år (U, R).

[1] (R) = exemplar i Riksmuseet, (U) = exemplar i Uppsala botaniska museum.

Hietaniemi s:n:

Juxta Hietaniemi, L. L. Laestadius, 1831 (U); Juxta Hietaniemi in insularum ripis inundatis, 1831 (R); namn saknas, men så vitt jag kan finna, tillhör handstilen L. L. Laestadius. Då materialet på de båda arken troligen insamlats vid samma tillfälle och på samma plats, och då öarna i älven vid Hietaniemi uteslutande tillhöra Finland, synes det mig sannolikt, att förekomsten i c k e är att räkna såsom svensk.

Niemis gästgivargård, R. F. Fristedt och F. J. Björnström, 1852 (R).

Över Torneå s:n:

Över Torneå, C. R. Asp, 1872 (R), 1874 (U, R); D:o, E. A. Bergendahl, 1875 (R); D:o, A. N. Lundström, 1892 (U); Kuivajärvi i byn Kuivakangas, A. Frisendahl, 1924 (R).

I Uppsala-herbariet finnes ett ark, som enligt den tryckta etiketten är insamlat vid Töre älv 1899 av E. Frisendahl. Enligt vad kollektören själv brevledes meddelat mig, föreligger här ett tryckfel för Torne älv.

Av ovan nämnda förekomster har jag funnit följande omnämnda i litteraturen (med bortseende från flororna):

Salminanti och Säivis, O. R. Fries (1858);

Antnäs, Svenonius (1925);

Niemis, R. F. Fristedt (1853).

På arket från Hietaniemi i Uppsala-herbariet har Laestadius skrivit: »... ad flumen Tornense pluribus locis copiose, a Torneå Stad usque ad Turtula,...». Av Laestadius' uppgift framgår icke, om han sett arten i det svenska eller i det finska Turtola. Säker uppgift om dess förekomst i det finska Turtola finnes hos Hjelt och Hult (1885). Däremot har jag i c k e funnit någon säker uppgift om, att den skulle växa i det svenska Turtola. Jag har också själv förgäves eftersökt den därstädes. Den i det följande omnämnda nya fyndorten vid Soukolojärvi i Över Torneå s:n är därför enligt min mening den för närvarande nordligaste säkra s v e n s k a fyndorten för *Arctophila*. — Ytterligare svenska fyndorter har jag icke funnit omnämnda i litteraturen.

Från Torneälvens finska sida omnämnes arten av Hjelt (1895) från följande platser: Turtola, Alkkula, Juntti och Torneå.

Sistförflutna sommar (1930) företog jag i sällskap med studeranden B. Ulander, Luleå, en resa genom Norrbottens nordliga delar för undersökningar över vattenvegetationen därstädes. På de erkursioner, som härvid gjordes, anträffade jag *Arctophila* på ytterligare tvenne lokaler, nämligen i:

Hietaniemi s:n: vid sjön Armasjärvi (3. 8. 1930);

Över Torneå s:n: vid sjön Soukolojärvi (12. 8. 1930).

Då inga eller synnerligen knapphändiga uppgifter lämnas i litteraturen om *Arctophila*-fyndorternas övriga vegetation och naturbeskaffenhet, anser jag ett utförligare omnämnande av dessa vara på sin plats.

Armasjärvi är en tämligen stor sjö (5,5 km lång, 1 km bred), belägen 49,8 m ö. h. Den avrinner genom en 5 km lång å till Torne älv. Nivåskillnaden mellan sjön och älven torde vid normala vattenstånd uppgå till omkring 3,5 m. Sjöns vattenståndsväxlingar äro efter allt att döma obe-

tydliga. Utefter östra sjöstrandens sydliga del ligger byn Armasjärvi med sina gårdar och åkrar. En bred zon av frodig *Equisetum limosum* följer stranden nedanför byn; i detta *Equisetum*-bälte växa därjämte en del andra vattenväxter. *Arctophila* anträffades nedanför byns nordligaste del. Den växte där från några få cm över vattenlinjen ut till ett djup av ungefär 25 cm. (Vattenståndet vid vårt besök var normalt sommarlågvattenstånd.) Hela arealen för dess förekomst uppskattades till cirka 75 m². Inom ungefär en tredjedel av detta område växte den i rent och tätt bestånd, rikligt fertil. Inom resten av området förekom den glesare och tillsammans med följande arter: *Equisetum limosum, Scirpus palustris, Carex aquatilis, Sagittaria natans, Callitriche verna, Potamogeton pusillus, Subularia aquatica, Elatine hydropiper* och *Scirpus acicularis*. Det kanske förtjänar omnämnas, att i omedelbar närhet av *Arctophila* men icke annorstädes vid sjön anträffades också några individ av *Alisma Plantago aquatica*, som i dessa trakter är sällsynt och befinner sig nära sin nordgräns. Bottnen var tämligen fast och bestod huvudsakligen av fint oorganiskt material.

Vid Soukolojärvi äro förhållandena ganska olika de ovan skildrade. Soukolojärvi (cirka 3,5 km lång och 1 km bred) ligger 49,3 m ö. h. och står genom en ungefär 2 km lång å i öppen förbindelse med Torneälv. Vattenståndsväxlingarna äro därför i likhet med älvens mycket stora, och vid stränderna finner man breda glidzoner för vattenlinjen utan tätt sluten vegetation. *Arctophila* växte vid en bukt på sjöns nordöstra sida inom övre delen av glidzonen. Bottnen var fast och bestod nästan uteslutande av fint oorganiskt material. Förekomsten var liten och mycket illa åtgången genom betning. Ståndortens viktigaste arter voro utom *Arctophila* följande 3: *Polygonum amphibium, Scirpus palustris* och *Sagittaria natans*. Dessutom förekommo enstaka: *Elatine triandra, E. hydropiper, Subularia aquatica, Callitriche verna, Ranunculus reptans, Scirpus acicularis, Sparganium* cfr *Friesii* × *simplex* och *Alisma Plantago aquatica*.

3. De nordligaste svenska fyndorterna för några vattenväxter.

Potamogeton zosterifolius Schum. är tidigare inom Sverige känd nordligast från Persöfjärden ett par mil norr om Luleå (Svenonius 1925). — Sommaren 1929 gjorde jag erkursioner i Norrbotten i sällskap med fil. stud. P. Enequist, Luleå. Härunder anträffades *Potamogeton zosterifolius* på tvenne betydligt nordligare (och högre) belägna lokaler, båda inom

Korpilombolo s:n: Korpilombolo (sjön vid kyrkbyn med samma namn, 158 m ö. h.); Pirtijärvi (159 m ö. h.).

I Korpilombolo (9. 8. 1929) växte den sparsamt i en liten vik i sjöns nordvästra ända. I Pirtijärvi (11. 8. 1929) anträffades två individ i sjöns nordvästra vik.

Under de förut omnämnda exkursionerna sistlidna sommar anträffade jag arten på ytterligare tre lokaler, alla belägna ännu längre norrut:

Tärändö s:n: Saittajärvi (211 m ö. h.);

Pajala s:n: Kaunisjärvi (160 m ö. h.);

Muonionalusta kap.: Muodosjärvi (232 m ö. h.).

I Saittajärvi (17. 8. 1930) iakttogos några få individ i en liten vik utanför

en bäckmynning vid sjöns nordvästra strand bland vegetation, som för övrigt så gott som uteslutande bestod av riklig *Sparganium* cfr *simplex* (fertil och otvetydig *S. simplex* växte nära stranden, de sterila individen längre ut tillhörde efter allt att döma samma art), vidare anträffades spridda exemplar i sällskap med *Potamogeton praelongus* inuti ett glest bestånd av *Equisetum limosum* vid västra stranden.

Vegetationen i sjön Kaunisjärvi (16. 8. 1930) var mycket frodig. *P. zosterifolius* anträffades i oerhörda mängder i ett brett bälte utanför den tätt slutna vegetationen av näckrosor (*Nymphaea candida, Nuphar luteum*). Om man förde ned en åra mot bottnen, fick man upp den alldeles fullbehängd med stora och grova individ av arten ifråga.

I Muodosjärvi (19. 8. 1930) anträffades arten talrikt i den smala nordvästra viken (nordost om Muodosjoki), vidare vid sundet mellan den östra och den västra sjödelen. Den växte i sällskap med *Potamogeton praelongus, Nuphar luteum* × *pumilum, Sparganium* sp. m. fl. arter. Fyndorten är den nordligaste i Sverige för *Potamogeton zosterifolius* (67° 57′). Den tycks också vara den nordligaste hittills iakttagna överhuvud. Den ligger ungefär 25 mil längre norrut än den nordligaste förut publicerade svenska lokalen och mer än 10 mil nordligare än de nordligaste finska lokalerna i södra Lapponia kemensis (i Kemijärvi och Kuolajärvi, Linkola 1927). (I Norge är arten iakttagen endast i landets sydöstra delar.) Samtidigt är höjdstigningen över havet också ovanligt stor. Endast artens tvenne Jämtlandsförekomster ligga några meter högre.

Arten var steril i alla sjöarna med undantag för ett par individ i Korpilombolo.

Potamogeton obtusifolius M. et K. är förut icke känd från Norrbotten (ej heller från Västerbotten). Denna art har jag åren 1929 och 1930 anträffat på icke mindre än 8 Norrbottens-lokaler, nämligen:

Neder Luleå s:n: Bälingsträsk, nordvästra viken (1. 8. 1929);

Råneå s:n: Dynträsket, rikligt (14. 8. 1929);

Karl Gustaf s:n: Lappträsk station, Rutajärvi, 1 exemplar erhölls i skrapan vid skrapning i sjöns nordöstra vik (28. 7. 1930);

Korpilombolo s:n: Korpilombolo, sjöns nordvästra ända (9. 8. 1929); Pirtijärvi, nordöstra viken (11. 8. 1929);

Över Torneå s:n: Vähälompolo (efter vägen Svansten—Aapua) (15. 8. 1930);

Muonionalusta kap.: Muodosjärvi, innersta delen av den nordvästra viken (19. 8. 1930); Merasjärvi, en lös gren anträffades drivande i sjöns södra ända (19. 8. 1930).

Förekomsten i Muodosjärvi är hittills den nordligaste i Sverige (67° 57′). En isolerad norsk förekomst i Troms fylke är nordligare belägen. Från norra Finland är arten nordligast känd från Sodankylä, som ligger i Lapponia kemensis, några mil sydligare än den nordligaste svenska lokalen. I Holmbergs flora (1922) anföres denna i förhållande till övriga kända finska förekomster ganska isolerade lokal med en viss tvekan: »även uppgiven för KeL. Sodankylä». Efter de ovan omtalade svenska fynden anser jag ingen anledning längre föreligga att betvivla uppgiftens riktighet.

Exemplaret från Rutajärvi och den drivande grenen i Merasjärvi voro sterila, i alla de andra sjöarna anträffades fertilt material.

Alisma Plantago aquatica L. förekommer i Norrbotten nordligast i Över Kalix och Över Torneå socknar. Den hittills nordligaste av alla lokalerna ligger inom norra delen av Över Torneå s:n, vid nordändan av sjön Rantajärvi (66° 43′, 122 m ö. h., 14. 8. 1930), cirka 1 mil nordväst om Svansten. Stränderna äro vid sjöns nordända utskurna i torvjord, och där förekommer *Alisma* rikligt i stora, väl utvecklade exemplar. — Förekomsten är som nämnt den nordligaste i Norrbotten; den är samtidigt så vitt jag kunnat finna den nordligaste i Sverige; dock ligger den endast obetydligt längre mot norr än förekomsten vid Purkijaur vid Jokkmokk i Lule lappmark. I Norge går arten till cirka 64° 30′, inom det finska floraområdet är den känd till samma breddgrad som nu i Sverige.

Lemna minor L. anträffades rikligt i myrjordsdiken nedanför byn Armasjärvi (66° 18′) vid sjön Armasjärvi i Hietaniemi s:n (3. 8. 1930). Arten är tidigare inom Norrbotten känd endast från några få lokaler i närheten av kusten, den nordligaste synes vara Sangisälvens utlopp (O. R. Fries 1858). I Norge är arten känd till 65° 53′ (Blytt 1906), i Finland till 65° 50′ (Hjelt 1892).

Lobelia Dortmanna L. iakttogs i Norrbotten första gången av O. R. Fries (1858) i sjön Gäddträsk nära Sangisälven i Neder Kalix s:n. Under de tvenne följande decennierna måtte den ha iakttagits på flera lokaler, ty hos Backman och Holm (1878) får man följande upplysning om artens utbredning i Norrbotten: »Kalix s:n flerestädes». Några senare uppgifter har jag icke funnit. — Sistlidna sommar anträffade jag *Lobelia* i några sjöar i trakterna kring Lappträsk station:

Karl Gustaf s:n: Rutajärvi; Korpijärvi; Haukijärvi;

Hietaniemi s:n: Penikkajärvi; Pallakkajärvi.

I alla sjöarna var den rikligt fertil. I de fyra förstnämnda sjöarna uppträdde den rikligt, i Pallakkajärvi anträffades endast ett litet bestånd vid stranden nedanför byn Pallakka. Den sistnämnda förekomsten är hittills den nordligaste i Sverige (66° 9′, 81 m ö. h.). Vid Norges västkust är den känd till 68° 9′ (Blytt 1906), i Finland till 66° 40′ (Hjelt 1923).

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Uppsala den 9 oktober 1930.

Gunnar Lohammar.

Sporadisk och temporär förekomst av förvildade och mindre allmänna kärlväxter på Utö.

Dessa anteckningar offentliggöras utan minsta anspråk att kunna bidraga till forskningen något utöver ett par förut troligen ej kända fyndorter och några närmare uppgifter om lokaler, som i »Stockholmstraktens växter» i största allmänhet omtalas. Till grund ligger dock ett mindre vanligt tillfälle till iakttagelser under en rad av 21 år, och det delvis under alla tider på året. Uppgifterna syfta huvudsakligen på den ungefär rektangulära, i sydväst delvis sanka, mossaktiga, i nordost däremot ett djupt lager av grusblandad havssand uppvisande slätt, på vilken förf:s lilla täppa är belägen (på den lilla geologiska kartan i Sthmst. v., sid. xxxiv på urkalkstensområdet). I denna täppa har under de sista 15 åren huvudsakligen en samling inhemska växter kultiverats, och dessas benägenhet att förvildas har noga observerats.[1] Kultiverade prydnadsväxter ha från förf:s och andras trädgårdstäppor förvildats, och för deras uppträdande och försvinnande lämnas några uppgifter; f. c. = forma culta.

Aquilegia vulgaris ff. cc. Trädgårdsflykting vid Herrgården bakom Restauranten, vid Stenstugorna, vid Silvervillan. Synnerligen konstant; tidig frömognad.

Armoracia rusticana. På potatisland odlad och spridd samt kvarlevande, då dessa land övergivits; slättens sydvästända. Ingen blomning.

[1] Det i vissa delar avsiktligt igångsatta förvildnings- och förfallexperimentet har under 4—5 år ej tillfogat täppan större skada, än att 1930 över ett 30-tal fröslag kunnat inhöstas.

Asplenium Ruta muraria. Järnholmen.

Artemisia Absinthium. Ovanligt ymnig på slätten, överallt trädgårdsogräs.

Aster Tripolium. De senaste 2—3 åren vida vanligare i den s. k. havssidans vikar än förut. Växer i odling till jätteexemplar och sår sig själv.

Calla palustris. Några få exemplar i en skogspöl vid den s. k. »Slavaskogens» mot Fladen vända sumpiga ända; mogna frukter.

Carlina vulgaris. Sporadisk på slätten, vissa somrar borta; steril fruktsättning iakttagen.

Chrysanthemum Parthenium. Från trädgårdarna spridd bl. a. vid bryggan.

Cornus suecica. Längs den s. k. havssidan, vid Lilla Sillsviken, ovanligt ymnig i en djup ravin nära Södra Sandviken; kultur har misslyckats under alla år.

Cotoneaster integerrima. Enstaka, delvis gamla exemplar på hällarna nära skolan; bakom en gammal källare söder om slätten ett jätteexemplar med tättliggande växtsätt, en enda sommar (1929) med mogna bär.

Cymbalaria muralis. Förökar sig och sprider sig genom självsådd — arten är icke härdig — ett par år, men dör utan tillsyn.

Cynanchum Vincetoxicum. Många exemplar på klipporna söder om Brandvarpet vid en inre vik.

Fragaria moschata. Förvildad innerst inne i Stora Sillsviken, blommar ej.

Geranium molle. Temporärt på slätten, men aldrig ymnigt.

Hyoscyamus niger. Omkr. 1918 allmänt ogräs vid Gruvorna, nu sällsynt vid slättens sydsida.

Impatiens Roylei. Från Svartsstugans täppa spridd ända in i skogen.

Iris Pseudacorus. Mycket vanlig i kärren mellan Gruvorna och Fladen, ibland utbredd ned till havsvikarna, men där av kort livslängd.

Isatis tinctoria. Enstaka stora exemplar vid S. Sandviken och på Runmaren, självsådd i regeln endast omedelbart under moderplantan; vackra ettåriga rosetter.

Lamium album. Sällsynt, endast som trädgårdsogräs.

Lathyrus maritimus. Stora Björn och vid Källviken, på båda ställena reducerad av betande kreatur.

L. tuberosus. Höll på att sprida sig från min täppa ut på slätten, men dog år 1924 tvärt ut överallt.

Lemna minor. I tånggölar, vanligen kortlivad (jfr *Iris*).

Lilium bulbiferum. Ur gamla trädgårdar spridd på slätten över ängarna på nordsidan och i skogsbrynet. Odlad vid »Byggningen» (Fågelsången), därifrån i ett stort antal lökar inflyttad i täppan. Sedan fjolåret överallt utdöd, hos mig en enda svag planta kvar. Bulbillerna bildas mycket sent, veckor efter *L. tigrinum*'s.

Linaria repens. Ur handelsträdgårdar spridd till min täppa och därifrån med plantor till alla granntäpporna.

Linum perenne. Förökade sig frodigt i åratal och förvildades, men var efter några år utdöd överallt.

Lonicera Symphoricarpos. Kvarstående från gamla trädgårdar på slätten; genom rotskott mycket utbredd buske.

L. Xylosteum. Stora, gamla exemplar på ängarna »Trema» intill Blombergs hage.

Lycopsis arvensis. Vägogräs längs hela Lurgatan; nedliggande växtsätt.

Malva moschata. Genom frö spridd på ängarna och dikeskanter på slätten och vid Sjödal.

Medicago lupulina. Enstaka år ymnig längs stigen i rak linje ned till havet, 1930 fullkomligt försvunnen.

Muscari botryoides. Ur en gammal trädgård, som legat bakom stugan längst i sydost på slätten, spridd på ängen vida omkring, särskilt i skydd av några gamla syrener.

Nepeta Cataria. Som ovan *Malva.*

Prunus avium. Sedan gammalt planterad vid Utö-stugorna och frodigt utvecklad på kalkgrunden samt ymnigt spridd genom utlöpare och sådd i skogen.

P. Institia. En jättebuske 10 m i omkrets — med utlöpare från »Slottet» ända till min täppa; sällan blommande, en enda sommar sedd med någon mogen frukt.

Ribes aureum. Tre olika varieteter (gula, bruna och svarta bär, olika bladfärg och olika habitus), yvigt växande och utträngande genom enstaketet för att på ängarna omkring föröka sig vegetativt.

Rosa rugosa. En högväxt, ljusskär, spetsbladig trädgårdshybrid med våldsam skottbildning; samma förhållande som med *Ribes.*

Satureia Acinos. På hällarna i slättens sydöstra hörn ymnig, eljest sällsynt.

Scutellaria hastifolia. Uppenbarligen nu mera sällsynt än förr. På de två lokaler jag fann den, vid Stora Sillsviken och vid S. Sandviken, befanns det, att stora massor av i sanden krypande, blomlösa skott, tillhörde ett enda individ. På 21 år har jag ej lyckats finna ett moget frö, i år ingen blomma.

Sedum album. På en av Gruvans stora malmhögar konstaterades ett totalt försvinnande av denna art, ett eller två år efter det *S. album* där växt och blommat så rikligt, att den svarta stenhögen var helt vit. Den enorma malmhögen har stått orörd.

S. album var. *pallens.* Rätt vanlig å skogshällarna mot havssidan, men påfallande ännu mera vanlig på slätten nära stugorna. Blommar sällan, är säkert icke identisk med den av mig tillsammans med den vilda avarten odlade trädgårdsformen »*Sedum balticum*».

S. maximum. Omfattar tydligen två olika typer: en mera blågrön, rödstjälkig på klipporna, och överallt på slätten i stor ymnighet en grövre, saftigt grön, grönstänglig form.

S. spurium. På hällar, som det i årtionden trampats på, i närheten av »Byggningen» på slätten.

Sempervivum sp. Av mig för 19 år sedan insamlad på en mur nära Stenstugorna, från min täppa återigen spridd i granntäppor och utanför.

Solanum Dulcamara. Jätteexemplaret vid S. Sandviken nu utdött, skott jag tagit därav och förökat ha bidragit till spridning av arten på slätten.

S. nigrum. Trädgårdsogräs för några år sedan, nu försvunnet.

Thalictrum flavum. Förr mycket ymnig på mossen på vägen ned till S. Sandviken, nu tydligen på retur; blommar föga och lämnar nästan ingen mogen frukt.

Trifolium fragiferum. Sällsynt; på de tre kända lokalerna, vid Kyrkviken i boskapsstigarna, vid sjöbodarna i en havsvik i söder och vid Varmbadhuset är fröet tydligen spritt av trampandet.

Veronica longifolia var. *maritima.* Ymnig på Runmaren, enstaka plantor vid havssidan i tångalluviet.

V. spicata. Ymnig på stenhällarna på slåtten; troligen även en hybrid med *longifolia*-liknande blad.

Vicia lathyroides. Försvunnen från grästorven kring Restauranten.

V. tetrasperma. Sällsynt i gräset längs vägen till havssidan.

Woodsia ilvensis. Ymnig i sprickor på hällar åt havssidan till.

Henry B. Goodwin.

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Under år 1930 ha hittills av detta standardverk utkommit två band, behandlande fanerogamer. Det ena av dessa, Band 15 a, är redigerat av Diels och omfattar en del av monokotyledonerna, nämligen serierna *Farinosae, Liliiflorae* och *Scitamineae.* En jämförelse med motsvarande partier i första upplagan, utkomna 1888—89, visar, att några ändringar i den systematiska uppställningen icke ägt rum. De olika familjerna behandlas i samma ordning som förut. Av medarbetarna från förra upplagan återfinner man endast Engler och Pax. Av stort intresse är den översikt av de tre här behandlade seriernas inbördes släktskap och systematiska uppställning, med vilken Engler inleder bandet.

De flesta familjer äro betydligt utförligare behandlade än i första upplagan, och illustrationerna äro mycket talrikare, så att den nya bearbetningen till sidantalet svällt ut till åtskilligt mer än dubbelt mot förut. Denna utvidgning av arbetet är ju ganska naturlig och ofrånkomlig, då man betänker, vilket intensivt arbete, som under de senaste årtiondena utförts på botanikens alla områden, icke minst inom systematiken och floristiken.

För samtliga familjer föreligga fullständiga nybearbetningar. Av dessa ha *Bromeliaceae, Liliaceae* och *Zingiberaceae* ökat mest i omfång. Familjen *Liliaceae,* bearbetad av Krause, upptager det största utrymmet, vilket är helt naturligt dels på grund av dess storlek, dels i följd av dess ställning som grundtypen inom *Liliiflorae.* I motsats till flera andra systematiker, som delat upp *Liliaceae* i ett större eller mindre antal självständiga familjer, har Krause bibehållit den som en enhet, ehuru indelad i tolv underfamiljer. Han följer härvid Engler i senaste upplagan av Syllabus der Pflanzenfamilien.

Inom serien *Farinosae* ha två nya familjer tillkommit, nämligen *Thurniaceae,* omfattande det enda släktet *Thurnia,* tidigare fört till *Juncaceae,* och *Cyanastraceae* med släktet *Cyanastrum,* förr räknat till *Pontederiaceae.* Den senare familjen upptages redan i supplementet till första upplagan, och båda ha funnits i de senare upplagorna av Syllabus.

Det andra under år 1930 utkomna fanerogambandet, nr 18 a, omfattar serien *Podostemonales* och underserien *Saxifragineae* av *Rosales.* Även i

detta fall har bearbetningen svällt ut starkt i omfång. Som redaktör för bandet står HARMS, vilken dessutom ensam eller i samarbete med annan forskare behandlat flera av de däri upptagna familjerna. ENGLER har bl. a. skrivit *Podostemonaceae* och *Saxifragaceae,* och framställningen av *Crassulaceae* har författats av BERGER under medverkan av HARMS.

Podostemonales omfattar den enda familjen *Podostemonaceae,* som tidigare räknades till *Rosales,* men nu blivit utbruten som egen serie. En jämförelse mellan förra och nya upplagan av Pflanzenfamilien visar, hur kännedomen om familjen såväl i floristiskt avseende som i fråga om dess morfologi, utvecklingshistoria m. m. ökats mellan 1891 och 1930. Släktet *Hydrostachys,* som i första upplagan fördes till *Podostemonaceae,* blev ju strax efter dennas utgivande uppställt som en egen familj, och i sin inledning till *Podostemonales* skriver ENGLER, att han betraktar *Hydrostachyaceae* som en självständig serie, *Hydrostachyales,* tills vidare placerad mellan *Piperales* och *Salicales.*

Även till serien *Rosales* har ENGLER skrivit en inledning, där han redogör för sin uppfattning av dess släktskapsförhållanden och systematiska indelning. De familjer, som tillkommit efter förra upplagan och dess supplement, äro *Eucommiaceae, Byblidaceae* och *Roridulaceae.* Den förstnämnda av dessa utbröts ur *Hamamelidaceae* av VAN TIEGHEM, och till dennes åsikt har ENGLER anslutit sig. De två andra familjerna äro grundade på släktena *Byblis* och *Roridula,* som tidigare räknades till *Droseraceae.*

I nya upplagan behandlas familjerna ungefär i samma ordning som förut. Huvudparten av utrymmet upptaga *Saxifragaceae* och *Crassulaceae,* som båda fått en synnerligen utförlig behandling. Den förra uppdelas i ej mindre än femton, den senare i sex underfamiljer.

En stor fördel hos den nya upplagan äro de översikter, som inleda varje serie. Genom dem får man en god orientering över de olika grupperna och över de grunder, på vilka den systematiska indelningen bygger. Sådana översikter saknades helt i första upplagan. Som helhet synas även uppställningen och rubrikernas anordning vara klarare och överskådligare i andra upplagan än i första.

Att gå in på någon utförligare redogörelse för banden skulle föra alldeles för långt och är dessutom knappast behövligt, ty det säger sig självt, att varje botanist, som skall sätta sig in i någon systematisk, floristisk eller växtgeografisk fråga, anlitar detta arbete som en av sina viktigaste källor och med glädje hälsar varje nyutkommet band. Det är tillräckligt att i korthet omnämna innehållet i de nya banden allt efter som de publiceras, till ledning för dem, som ej ha tillfälle att följa med bibliotekens nyförvärv.

K. Afzelius.

PINCUSSEN, LUDWIG. Mikromethodik. Quantitative Bestimmung der Harn-, Blut- und Organbestandteile in kleinen Mengen für klinische und experimentelle Zwecke. — 5. Aufl. 34 Abbild. Preis 7: 50 RM. Leipzig, Georg Thieme, 1930.

Som framgår av titeln är denna analysbok i första rummet avsedd för medicinsk-kemiska analyser. Flera av de beskrivna metoderna kunna emellertid användas även för växtmaterial.

Den nyutkomna upplagan är utökad med några nya metoder och med ett sakregister. Innehållet är indelat i allmänna metoder, urinanalys, blodanalys, askanalys av organ och faeces och slutligen de gasanalytiska metoderna för blodundersökning. I ett tillägg beskrivas några metoder för bestämning av vätejonskoncentrationen, där man tyvärr saknar CLARK och GILLESPIE's ur många synpunkter fördelaktiga metod.

I den allmänna delen beskrivas utomordentligt klart och koncist några enkla apparater för mikroanalys och deras användning. I övriga kapitel meddelas metoder för bestämning av såväl askämnen som organiska ämnen. Varje beskrivning indelas i princip, nödvändiga reagenser, utförande, beräkning av resultaten och ett numeriskt exempel. Detta gör, att hela handboken blir överskådlig och lätt att finna sig till rätta i. Flera av de beskrivna metoderna för analys av askämnen i urin kunna med fördel användas för asklösningar av växtmaterial; exempelvis har den å sid. 48 beskrivna metoden för kalciumbestämning blivit använd av referenten vid analys av växtaska (se denna tidskr., Bd. 24, sid. 172).

Efter urinanalysen behandlas blodanalysen och därefter askanalysen av organ och faeces. På sidorna 167—171 beskrivas några metoder för föraskning av organ. Den enklaste av dessa är upphettning av organet med rykande salpetersyra och perhydrol i ett centrifugrör, där sedan exempelvis kalcium kan bestämmas direkt. Denna metod har av referenten prövats med blad av *Fraxinus excelsior* L., varvid dock förbränningen trots fullständig avfärgning förblev ofullständig, vilket medförde betydligt för höga värden vid titrering på kalcium med kaliumpermanganat. Genomgående måste de i handboken skildrade metoderna prövas på föreliggande material, innan de användas.

Härvidlag märker man snart en stor brist i arbetet. Hänvisning till originalbeskrivningen av metoderna saknas i de allra flesta fall. Sådana hänvisningar till litteraturen skulle nämligen vara särskilt värdefulla, när det gäller att använda en metod för annat material än medicinsk-kemiskt. På det hela taget finnes emellertid för botanisten mycket värdefulla upplysningar att hämta i denna med stor sakkunskap givna redogörelse av den medicinsk-kemiska mikroanalysen.

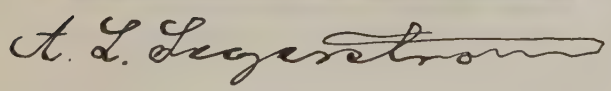
C. Philipson.

Svensk Botanisk Tidskrift. 1930. Bd. 24, H. 4.

IN MEMORIAM.

Arvid Lorentz Segerström.

* 11/8 1865, † 7/4 1930.



Den 7 april 1930 avled i Stockholm godsägaren Arvid Lorentz Segerström, 64 år gammal. Han led under de senare åren av åderförkalkning med högt blodtryck, men dödsbudet kom icke desto mindre för alla oväntat.

Arvid L. Segerström var född i Stockholm den 11 augusti 1865. Hans släkt leder sitt ursprung från Åland och närmare bestämt från Seglinge.

Han avlade 1881 gymnasistexamen i Katarina lägre allmänna läroverk. Som lärare i naturkunnighet hade Segerström kollegan, sedermera läroverksadjunkten Johan Herbert Hagelin. Denne var en mycket skicklig lärare, och hans exkursioner voro mycket omtyckta av ungdomen. Flera eftermiddagar och kvällar i veckan under höst och vår offrade han på exkursioner med sina klasser. De förlades på Segerströms liksom på undertecknads tid till Djurgården, Danviksbergen med Nacka och Rackarbergen med Tantolundens sluttningar mot Årstaviken, och utom växter samlades vattenödlor, grodrom och snäckor. Det naturintresse, som väcktes hos Segerström under skolåren, följde honom under hela livet. Sedan den unge Arvid genomgått Skara lantbruksskola 1896, var han bruksbokhållare vid Åvike bruk och förvaltare vid Karlsby bruk. Åren 1897—1904 ägde han Svartö gods i Östergötland och 1907—1910 Vackstanäs i Södermanland. Under åren 1904—1914 var han verksam som fondmäklare i Stockholm och drog sig sistnämnda år tillbaka till privatlivet. Närmast sörjes Segerström av maka, född Lindblad, två söner och en dotter.

Segerström var en intresserad amatörbotanist och florist med goda kunskaper. Särskilt nöjd med livet var han, då hans botanistvänner voro samlade hos honom för att taga del av sommarens växtskörd. Utom nedan uppräknade skrifter efterlämnade Segerström i ofullbordat manuskript »Sydvästra Tylöskogens flora», som avser en floristisk och växtgeografisk undersökning av detta områdes 7 socknar, grundad på fyra somrars noggranna och omsorgsfulla studier. I Svenska Botaniska Föreningen blev Segerström revisorssuppleant 1919 och revisor 1926. Sedan 1919 var han skattmästare i Botaniska Sällskapet i Stockholm och invaldes i kommittén för utgivande av andra upplagan av »Stockholmstraktens växter». Segerström var mycket plikttrogen, mycket noggrann, nästan pedantisk, och ytterst vänsäll.

E. S—g.

A. L. Segerströms utgivna skrifter.

1. Vårutflykten (av Svenska Botaniska Föreningen) till Salem. — Sv. Bot. Tidskr. 12 (1918).
2. Några växtfynd från Öland. — Ib. 14 (1920).
3. En botanisk utflykt till Österåker i Uppland 1920. — Ib. 16 (1922).
4. Ett tillägg till kännedomen om kärlväxtfloran i västra Västmanlands bergslag. — Ib. 17 (1923).
5. Gråalens (*Alnus incana* Moench) förekomst i nordvästra Östergötland och i Södertörn. — Ib. 21 (1927).
6. *Lamium album* L. f. *subintegerrimum* n. f. — Ib. 22 (1928).

SVENSKA BOTANISKA FÖRENINGEN.

Årsmöte.

Föreningen sammanträdde lördagen den 29 november 1930 å Stockholms Högskola under ordförandeskap av professor O. Rosenberg.

Sedan närmast föregående sammanträde hade föreningen genom döden förlorat fem av sina medlemmar, nämligen jägmästaren J. A. Amilon, Lidingö, läroverksadjunkten K. A. Osenius, Nyköping, statshydrografen J. V. Eriksson, Stockholm, overlærer J. Dyring, Oslo, och kassören N. Bergvall, Stockholm. Ordföranden lyste frid över deras minne.

Valet av befattningshavare för år 1931 utföll på följande sätt: till ordförande utsågs professor R. Sernander, till v. ordförande professor O. Rosenberg, till sekreterare och redaktör professor T. Lagerberg, till skattmästare docenten O. Heilborn, till övriga ledamöter i styrelsen professor R. E. Fries, rådman A. Hafström, professor H. Hesselman, professor O. Juel, lektor G. Malme, professor H. Nilsson-Ehle, professor G. Samuelsson samt lektor J. A. O. Skårman; till ledamöter i redaktionskommittén utsågos doktor S. Birger, professor T. Lagerberg, lektor G. Malme, professor G. Samuelsson, professor R. Sernander samt docenten M. G. Stålfelt. Till revisorer valdes direktör G. Indebetou och advokaten Hj. Karlsson med docenten C. Malmström och ingenjören J. Bergström som suppleanter.

Vid sammanträdet demonstrerade professor R. Fries ett levande exemplar av den i tropiska Asien hemmahörande *Aeginetia indica,* vilken uppdragits ur frö i Bergianska Trädgården med *Panicum plicatum* som värdväxt. Härefter höll fil. mag. E. Hultén föredrag om Kamtchatkaflorans geografiska utbredningstyper, illustrerat med talrika kartbilder.

Nya medlemmar.

Vid styrelsens sammanträde den 29 november 1930 invaldes följande medlemmar:

på förslag av lektor G. Malme:

folkskollärarinnan, fil. mag. Hanna Sundén, Stockholm;

på förslag av grosshandlaren E. Nordström:

kamreraren Hans Gustaf Maartman, Eskilstuna;

på förslag av lektor E. Teiling:

kontorsskrivaren V. Vinnerstedt, Huddinge;

på förslag av fru Elisabeth Ekman:
amiralinnan Julie Klintberg, Stockholm;
på förslag av doc. O. Heilborn:
tandläkaren Gösta Torell, Laholm;
på förslag av amanuensen E. Söderberg:
redaktören N. Stenlid, Stockholm;
på förslag av prof. T. Lagerberg:
professor O. Eneroth, Stockholm.

Tidskriftens statsanslag 1930.

I en till Kungl. Maj:t ställd underdånig skrivelse hade styrelsen anhållit att för fortsatt utgivande under år 1930 av Svensk Botanisk Tidskrift komma i åtnjutande av ett statsanslag om 2,000 kronor. Kungl. Maj:t har för berörda syfte tilldelat föreningen ett anslag om 1,500 kronor med skyldighet för föreningen att av tidskriften för samma år avgiftsfritt överlämna till ecklesiastikdepartementet 1 exemplar, till skolöverstyrelsen 66 exemplar, till botaniska institutionen vid universitetet i Uppsala 2 exemplar samt till pedagogiska biblioteket i Stockholm och riksdagens bibliotek vartdera 1 exemplar.

Nyförvärv till föreningens bibliotek.

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Från Botanisches Institut, Leipzig:
4 separat.
Från Professor Dr. A. A. Grossheim, Baky:
4 separat.

NOTISER.

Professuren i växtbiologi vid Uppsala universitet. — Till den efter professor R. Sernander under år 1931 ledigblivande professuren i växtbiologi hade vid ansökningstidens utgång den 3 december 1930 anmält sig följande sökande: docenten G. E. Du Rietz, Uppsala, professor N. Heribert Nilsson, Alnarp, professor H. Lundegårdh, Stockholm, professor L.-G. Romell, Cornell University, Ithaca, U. S. A., laborator M. G. Stålfelt, Stockholm och docenten G. Turesson, Lund.

Botanisk forskningsresa. — Under februari månad 1931 anträder akademiträdgårdsmästaren vid Uppsala universitet I. Örtendahl en botanisk forskningsresa till Sydvästafrika och Kaplandet. Under resan, som är avsedd att utsträckas över 8 månader, komma även botaniskt okända områden att besökas. De gjorda samlingarna äro i första hand avsedda för de botaniska institutionerna vid Uppsala universitet.

Till salu. — Schiffners mossexsickat, 13 fasciklar à 50 nummer jämte »Kritische Bemerkungen»; R. Hartmans mossexsickat; Limprichts bladmossflora, 3 band; Müllers levermossflora, 2 band; ett antal större och mindre arbeten och avhandlingar i bryologi av Arnell, Brotherus, Jensen, Lindberg, C. Müller, Kindberg, m. fl. samt Svensk Botanisk Tidskrift, fullständig serie.

Intresserade torde hänvända sig till undertecknad, som lämnar anvisning.

O. J. Hasslow.
Adr. Hanaskog.